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RRS *Discovery* Cruise 382

08 OCT – 24 NOV 2012

RAPID moorings cruise report

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| ABSTRACT | |
| <p>This cruise report covers scientific operations conducted during RRS <i>Discovery</i> Cruise 382. The purpose of the cruise was the refurbishment of an array of moorings spanning the latitude of 26.5°N from the Canary Islands to the Bahamas. Di382 departed from Southampton on Monday 8th October 2012, calling at Santa Cruz de Tenerife and Nassau, Bahamas before finally docking in Freeport, Bahamas on the 24th November 2012 after 47 days at sea. The full itinerary is described in Section 2.</p> <p>The moorings are part of a purposeful Atlantic wide mooring array for monitoring the Atlantic Meridional Overturning Circulation and Heat Flux. The array is a joint UK/US programme and is known as the RAPID-WATCH/MOCHA array. The array as serviced on Di382 consisted of a total of 17 moorings, 7 landers. This added to 7 landers and a single inverted echo sounder that had been deployed already. The US contributes 3 full depth moorings and 2 landers to the array. A full introduction is included in Section 3.</p> <p>During Di382 we recovered and redeployed: EBH1, EBH1L, EBH2, EBH3, EBHi, EB1, EB1L, EBH4, EBH4L, MAR3, MAR3L, MAR2, MAR1, WB6, WB1, WB4, WB4L, WB2, WB2L, WBH2, WBAL, WBADCP. EBH5 was recovered but not re-deployed. MAR1L, MAR0 were not recovered but were redeployed. WBP1 was the first deployment of a PIES lander in the western boundary. A sediment trap mooring NOGST was also recovered and redeployed for the Ocean Biogeochemistry and Ecosystems Group at the NOCS. Mooring operations and data processing are described in Sections 8 and 9. Diagrams of deployed moorings are included in Section 20. Logsheets of all recoveries and deployments of moorings are included in Sections 21 and 22.</p> <p>CTD stations were conducted throughout the cruise for purposes of providing pre- and post-deployment calibrations for mooring instrumentation and for testing mooring releases prior to deployment. CTD operations and data processing are described in Sections 6 and 7.</p> <p>Shipboard underway measurements were systematically logged, processed and calibrated, including: surface meteorology, 6m depth sea temperatures and salinities, water depth, navigation. Water velocity profiles from 15 m to approximately 800 m depth were obtained using a ship mounted 75 kHz acoustic Doppler current profiler. Shipboard measurements are described in Sections 4 and 5.</p> <p>Five APEX argo floats and five SVPs (surface velocity probes), supplied by the Met Office, were deployed during the cruise. Nine SVP plus salinity drifters were deployed for the SPURS project. These are described in Section 10.</p> <p>Summaries of instruments tested on CTDs, moored instrument record lengths, lost/damaged instruments, deployments, recoveries, acoustic releases and all RAPID cruises are included in Sections 13 to 19.</p> | |
| KEYWORDS | |
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1 Scientific and Ship's Personnel

Southampton-Nassau

Scientific Personnel

| | |
|---------------------|----------------------------------|
| Gerard McCarthy | Principal Scientist, NOC |
| Darren Rayner | Senior Scientist, NOC |
| David Smeed | Senior Scientist, RAPID PI, NOC |
| Ben Moat | Senior Scientist, NOC |
| Charlotte Mielke | PhD Student, Universitat Hamburg |
| Rafael Jaime Catany | MSc Student, NOC |
| Alex Clarke | Volunteer |

Technical Personnel

| | |
|---------------|------------------------------------|
| Rob McLachlan | Senior Technical Officer, Moorings |
| Jeff Benson | CTD Technician |
| Steve Whittle | Moorings |
| Colin Hutton | Moorings |
| Dave Childs | Sensors |
| Chris Crowe | Sensors |
| Ian Murdoch | Base Engineering |
| Zoltan Nemeth | ITO |

Ship's Personnel

| | |
|------------------------|------------------|
| Peter Sarjeant | Master |
| Phil Gauld | Chief Mate |
| Mike Hood | 2nd Officer |
| Liam McClintock | 3rd Officer |
| Ian Slater | Chief Engineer |
| Mike Murray | 2nd Engineer |
| John Harnett | 3rd Engineer |
| Ian Collin | 3rd Engineer |
| Denis Jakobauferstroht | E.T.O. |
| Emeylyn Williams | Motorman |
| Stuart Cook | Bosun |
| Martin Harrison | Scientific Bosun |
| Steve Duncan | Bosun's Mate |
| Mark Moore | A.B. |
| Dickie Deal | A.B. |
| Stephen Gallagher | A.B. |
| Stephen Toner | A.B. |
| David Hartshorne | Purser |
| Peter Lynch | Head Chef |
| Dean Hope | Chef |
| Jacqueline Waterhouse | Steward |

Nassau-Freeport Changes

Ship's Personnel

| | |
|------------------|------------------|
| Peter Newton | Chief Mate |
| Bernie McDonald | Chief Engineer |
| John Hagan | 2nd Engineer |
| Declan Goode | 3rd Engineer |
| John Smyth | Motorman |
| Greg Lewis | Bosun |
| John MacDonald | Scientific Bosun |
| Robert Spencer | Bosun's Mate |
| William McLennan | A.B. |
| Garry Crabb | A.B. |
| Graham Bullimore | Purser |
| Mark Preston | Head Chef |
| Lloyd Sutton | Chef |
| Jeffery Osborn | Steward |

Technical Personnel

| | |
|--------------|--------------------------|
| Jason Scott | Senior Technical Officer |
| Paul Provost | CTD Technician |
| Dan Comben | Cruise Manager |

2 Itinerary

Gerard McCarthy

RRS Discovery departed Empress Docks, Southampton on the 8 October 2012 on her last scientific cruise: Cruise 382. This was to be our 25th RAPID cruise—8th on *RRS Discovery*—and was to be our most ambitious expedition to date.

Underway data systems (ADCP, TSG, Navigation, Bathymetry and Meteorological systems) were all activated shortly after leaving port. These are described in Section 5. Ashtech data were poor at the start of the cruise and gave persistent problems. The system was restored to working order on 10 October following removal and reattachment of the cable to aerial 4. The transmissometer and fluorometer components of the TSG system were regularly cleaned during the trip but gave consistent problems. The TSG itself was not cleaned, to preserve calibration, and was stable for the trip.

From Southampton, the ship sailed towards the RAPID moorings sites south of the Canary Islands. A deployment of an Argo float and Met Office SVP (Surface Velocity Probe) was undertaken on the transit down. Full details of Argo float and drifter deployments can be found in Section 10 and will not be described further in this itinerary. Two CTDs for pre-calibration of MicroCATs and testing of acoustic releases were also undertaken. Full details of the CTDs and the instruments tested on them are in Sections 6 and 7.

Moorings work began on the 15 October at the EBH1 mooring site. From here, we worked eastwards through EBH1, EBH1L, EBH2 to EBH3. Diplomatic clearance for work in Moroccan waters had not arrived at this stage so we could not complete EBH4, EBH5 and EBH4L that were in Moroccan waters. We resorted to a plan that had been created in the case of this eventuality: when redeployed EBH3 was extended to the surface and a new lander, EBH3L1, was deployed at this site.

The ship returned to port in Santa Cruz on the 18 October for repairs to the starboard lifeboat and to pick up an air conditioning unit. We departed Santa Cruz on the 21 October and headed for the offshore moorings of the Eastern Boundary: EBHi, EB1 and EB1L. The top MicroCAT on EB1 was observed to be at 12 m depth and the top floats were damaged with fishing gear. We concluded that the top float must have been on the surface. This led to the decision to remove 20 m of wire from the mooring when redeployed.

Diplomatic clearance arrived from Morocco on the 23 October. Following work at the EB1 site, which finished on the 25 October, we returned to recover the moorings at EBH3L1 (deployed earlier in the cruise), EBH4, EBH4L2 and EBH5. We deployed EBH4 and EBH4L4. A new EBH5 was not deployed as the extended EBH3 acted as sufficient back up for EBH4. This work in Moroccan waters was accomplished in one day on the 28 October.

From here we transited to MAR3 at 41°W: we encountered unseasonal weather in the form of the tail end of tropical storm Tony, which reduced our speed to around six knots for the time period 30 October to 2 November. The ship suffered a power cut at 08.00 on 31 October due to a short-out of a main circuit board. Most systems rebooted immediately. Oceanus was switched to a UPS to allow for safe shut down

in the event of a reoccurrence. Mount points were restored manually to Oceanus. A problem with the gyro feed to the ADCP was only discovered on the 6 November. This was eventually sorted by the rebooting of the gyro feed in the Comms room.

Surface velocity and salinity drifters were deployed for the SPURS project at 0.1° intervals from 37.7°W on 4 November (Section 10).

To regain time lost, no CTDs were performed at the MAR3 site. An excellent effort was put in by the technical team and crew at this site to keep the work to a single day that included the recovery and redeployment of MAR3, MAR3L and NOGST.

Good time was made transiting to the MAR1/2 site, allowing the recovery of MAR2 on 7 November. The first overnight CTD suffered from scrolling problems. A second CTD was successfully completed but scrolling problems remained. Attempts to release MAR1L6 on the morning of 8 November were unsuccessful in the morning. Communication with the releases were good; releases were believed to have fired but the lander did not move. An implosion was suspected. MAR1, the tallest mooring of the array, was recovered and deployed on the same day. A shortened MAR2 and a lander, MAR1L8, were deployed on the morning of 9 November.

MAR0 was due to be recovered on 10 November. However, the mooring failed to surface. Communications were intermittent but both releases returned a 'Release OK' command. In spite of attempts to release the mooring from four separate locations, it failed to move from the seafloor. A possible implosion of the large pack of eight glass near the bottom of the mooring was suspected: the remaining buoyancy would not have been enough to bring the mooring to the surface. The craggy seabed around this mooring location could also have been a factor. We redeployed MAR0 with extra buoyancy towards the top and in an apparently flatter region nearby.

WB6 was recovered and redeployed on 14 November. An extra glass was added to the mooring so that it was the same as the newly deployed MAR0.

We docked in Nassau on 16 November for a crew change (Section 1) and a change of a few of the technical staff. Mysteriously, Oceanus shut down in the morning between 06.00 and 07.15 and needed to be rebooted. We departed Nassau at 5.00 pm local time.

WB1 was recovered and re-deployed on the 17 November with the new crew and technicians slotting in quickly to the moorings operations. The 18 November saw the first day's work at the WB4 site, with a lander turned around and WB4 itself recovered. The rugby float chain gang kicked into action that afternoon in preparation for the deployment of WB4 on the 19th.

The 20th November saw the turnaround of WB2 and WB2L. WB2 is the backbone of the RAPID array—the most important mooring. The scientific party worked hard on the data and produced an updated MOC timeseries that night (See Figure 1 for a previous example).

Moorings work continued apace. WBH2, WBADCP and WBAL were recovered on 21 and redeployed on the 22 November. The weather had deteriorated on the 21st and remained against us for the rest of the trip.

A final bonus piece of work was completed on the 23rd with the deployment of WBP1—a PIES lander. A frame had to be fashioned for the PIES by modifying

an old lander frame. This entailed a long evening of angle grinders and welding for some members of the technical party. The finished product was to be the final deployment from *RRS Discovery*. CTD 18 was the final scientific act of the cruise and the final scientific act in *RRS Discovery*'s long career.

We docked to Freeport on 24 November after a long and successful cruise.

3 Introduction

Gerard McCarthy

The Atlantic Meridional Overturning Circulation (AMOC) at 26.5°N carries a northward heat flux of 1.3 PW (Johns et al., 2010). Northward of 26.5°N over the Gulf Stream and its extension much of this heat is transferred to the atmosphere and subsequently is responsible for maintaining north eastern European climate about 5°C warmer than the zonal average at this latitude. Previous sparse observations did not resolve the temporal variability of the AMOC and so it is unknown whether it is slowing in response to global warming as suggested by recent model results (Bindoff et al., 2007).

In 2004, NERC, NSF and NOAA funded a system of observations in the Atlantic at 26.5°N to observe on a daily basis the strength and structure of the AMOC. It is fair to say that this programme has revolutionised our understanding of the AMOC. Early in the project, Cunningham et al. (2007) demonstrated that the AMOC reveals dramatic richness of variability. As the timeseries has been extended, modes of variability have been revealed on seasonal (Kanzow et al., 2010; Chidichimo et al., 2010) and interannual (McCarthy et al., 2012) timescales. The latest published version of the timeseries from McCarthy et al. (2012) can be seen in Figure 1.

The RAPID-MOC programme is now in its eighth year. The NERC contribution to the first four years of continuous AMOC observations was funded under the directed programme RAPID Climate Change. A commitment to fund the array until 2014 was made under the programme RAPID-WATCH. The NSF and NOAA have also continued funding and commitments so that the system can continue operating at the same level of activity to 2014. A number of operational changes have been implemented on Di382, namely switching to an 18 month turnaround of the mooring, servicing the whole array in a single cruise and reductions in some of the moorings, that will allow funding to be stretched to 2015. Following a second successful international review in 2012, plans are being made to secure funding beyond 2015.

The objectives of RAPID-WATCH are to deliver a decade-long time series of calibrated and quality-controlled measurements of the Atlantic MOC from the RAPID-WATCH array, to exploit the data from the RAPID-WATCH array and elsewhere to determine and interpret recent changes in the Atlantic MOC and to investigate the potential for predictions of the AMOC and its impacts on climate.

3.1 The AMOC system

The Atlantic at 26.5°N is separated into two regions: a western boundary region, where the Gulf Stream flows through the narrow (80 km), shallow (800 m) Florida Straits between Florida and the Bahamas, and a transatlantic mid-ocean region, extending from the Bahamas at about 77°W to Africa at about 15°W (Figure 2). Variability in Gulf Stream flow is derived from cable voltage measurements across the Florida Straits (Baringer & Larsen, 2001), and variability in wind-driven surface-layer Ekman transport across 26.5°N is derived from either CCMP (Atlas et al.,

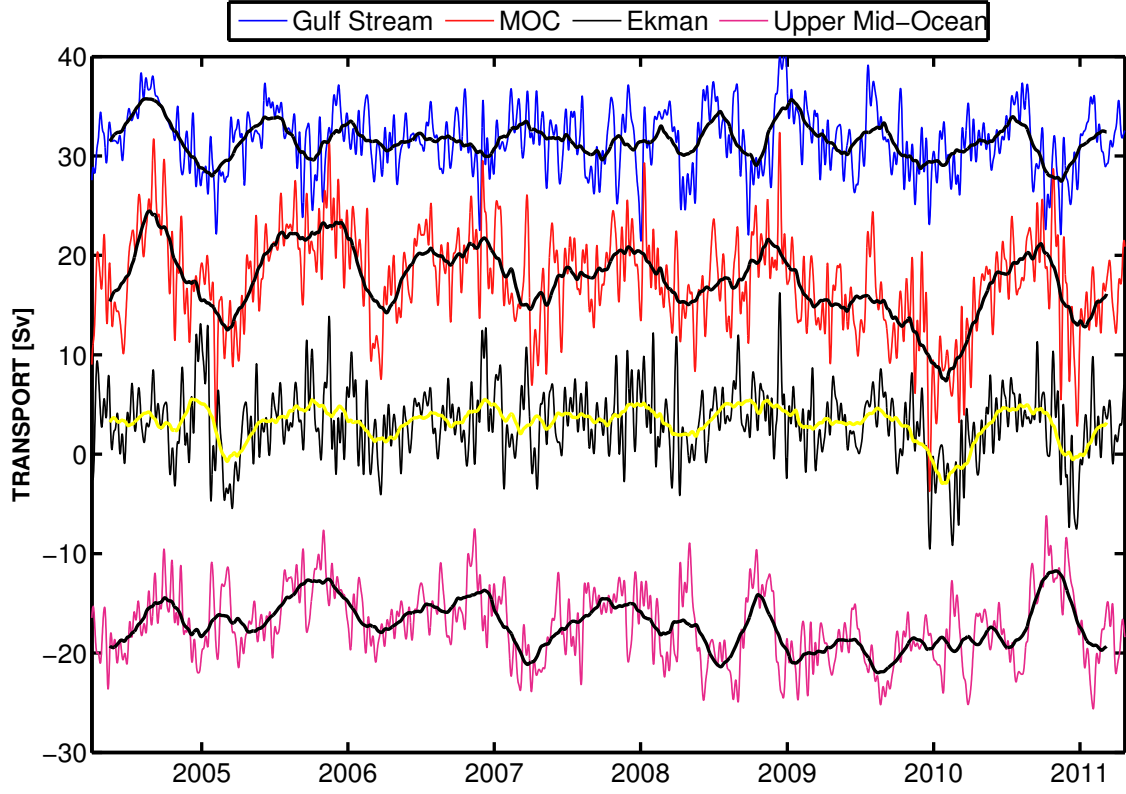


Figure 1: Ten-day (colors) and three month low-pass (black or yellow for Ekman) timeseries of Gulf Stream transport (blue), Ekman transport (black), upper mid-ocean transport (magenta), and overturning transport (red) for the period 1 April 2004 to 22 April 2011 based on the figure in McCarthy et al. (2012).

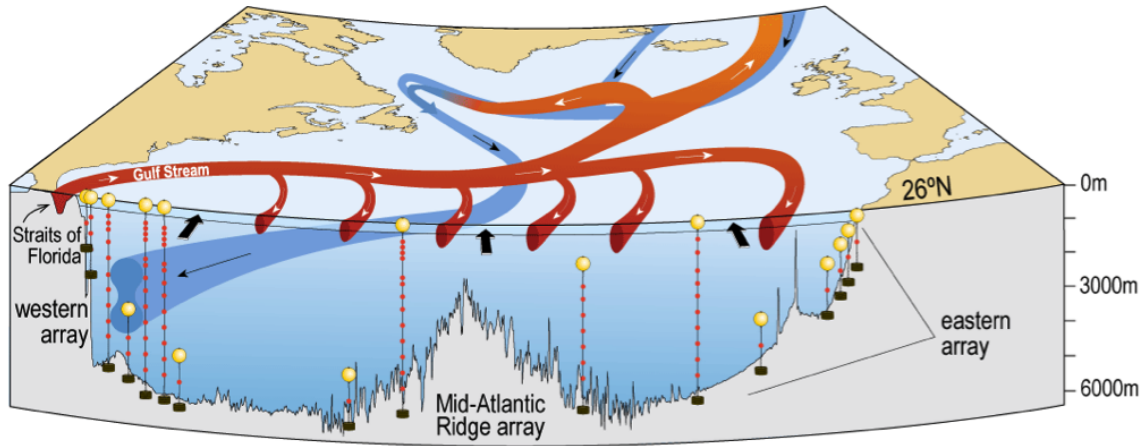


Figure 2: Schematic of the principal currents of the Atlantic meridional overturning circulation. The vertical lines across the Atlantic at 26.5°N indicate moorings instrumented to measure the vertical density profiles. The Gulf Stream (red) transport is measured by a submarine cable in the Straits of Florida and the western boundary array includes current meters to directly measure transports of the shallow and deep western boundary currents (blue). Bottom pressure recorders are located at several sites across the Atlantic to measure depth-independent fluctuations of the basin-wide circulation.

2011) or ERA-Interim winds (Dee & co authors, 2011).

To monitor the mid-ocean flow we deployed an array of moored instruments along the 26.5°N section. The basic principle of the array is to estimate the zonally integrated geostrophic profile of northward velocity on a daily basis from time-series measurements of temperature and salinity throughout the water column at the eastern and western boundaries. Inshore of the most westerly measurement of temperature and salinity, components of the Antilles current and deep western boundary current are monitored by direct velocity measurements. For a review, see Rayner et al. (2011).

3.2 Array Specification

The array refurbished on Di382 consists of a total of 17 moorings, 7 landers. This is added to the 7 landers and a single inverted echo sounder that had been deployed on previous cruises. Figure 3 shows the array before and after Di382.

Moorings are named in three sub-arrays. Western boundary WB with mooring number increasing to the east; Mid-Atlantic Ridge MAR; Eastern Boundary EB. The letter H is a historical reference to moorings originally intended to be HOMER profilers. Bottom landers instrumented with pressure recorders are indicated by L in the name. ADCP indicates an Acoustic Doppler Current Profiler mooring.

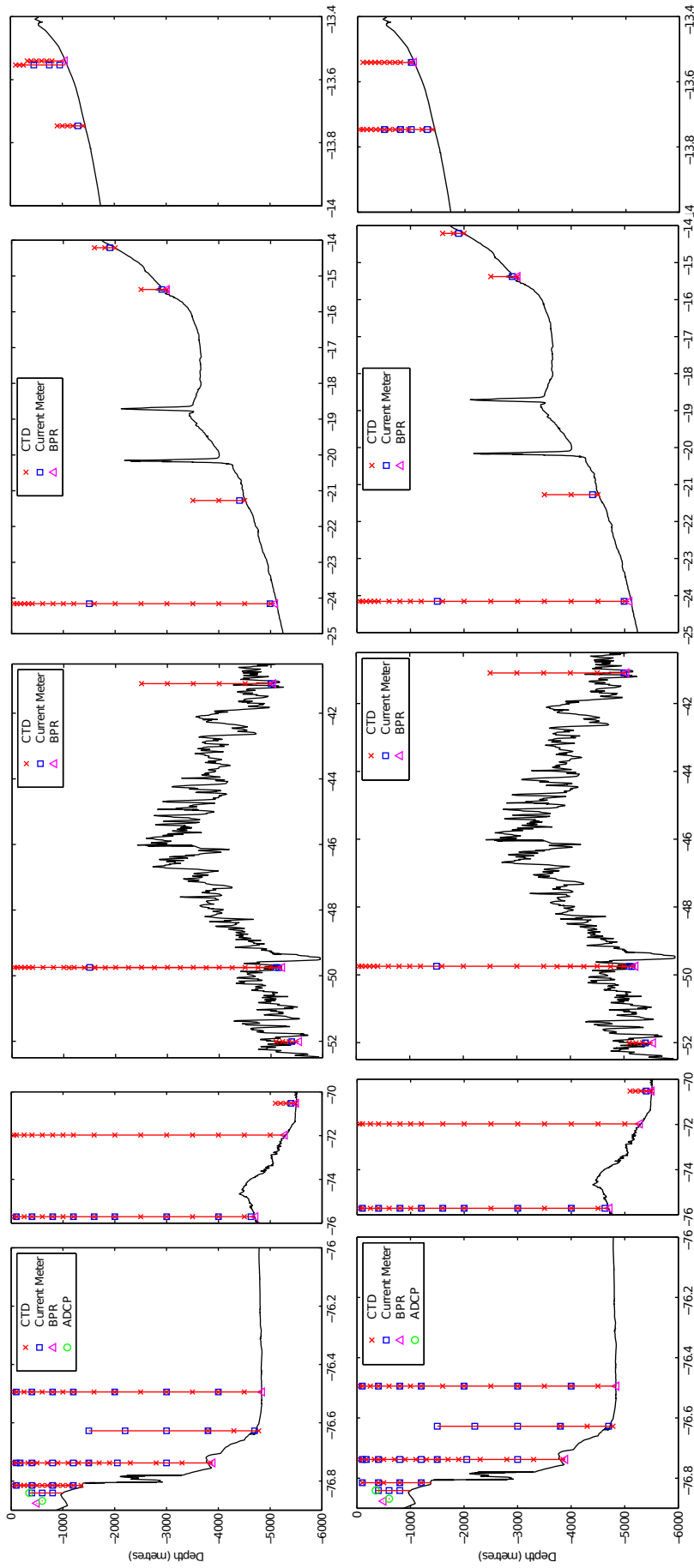


Figure 3: The RAPID/MOCHA array (top) before and (bottom) after Di382. Panels show, from left, the western boundary array at the continental shelf including WBADCP, WBAL, WB0, WB1, WB2, WBH2, WB2L and WB3. The deep western boundary array including WB4, WB4L, WB5 and WB6. The Mid-Atlantic Ridge array including MAR0, MAR1, MAR1L, MAR2, MAR3 and MAR3L. The deep eastern boundary array including EB1, EB1L, EBHi, EBH1, EBH1L and EBH2. The slope eastern boundary array including EBH3, EBH4, EBH4L and EBH5. Moorings WB0, WB3 and WB5 comprise the MOCHA element of the array. Modifications on this cruise include removing 11 MicroCATs from WB1, reducing the height of MAR2 to the permeable height of the ridge, extending EBH3 to the surface instead of EBH5 and extending EBH4 so that it covers the full water column from 0 to 1000 m.

Eastern Boundary Sub-array

The Eastern Boundary sub-array currently consists of one tall mooring EB1, consisting of eighteen MicroCATs and two current meters, and a series of shorter dynamic height moorings EBHi, EBH1, EBH2, EBH3 and EBH4 that step up the slope reducing the influence of bottom triangles when combined with the more offshore EB1 mooring. The Eastern sub-array includes six bottom pressure landers; two at the site of EB1, comprising two bottom pressure recorders (BPRS) each, two at the site of EBH1, comprising one bottom pressure recorder each and two at the site of EBH4. EBH4L was deployed close to the site of EBH4 as a replacement for the Inverted Echo Sounder with a pressure sensor (PIES) instrument that could not be redeployed during this cruise. The landers are serviced in alternate cruises so that each recovery provides a two-year record with a year overlap with the previous lander to help remove instrument drift. There is currently one PIES deployed in the eastern boundary sub-array, EBP2, which was serviced on Di359.

On Di382, a change was made to the array at the eastern margins: where previously EBH4 and EBH5 had been co-located providing a single density profile of the top 1000 m, on this cruise, EBH3 was extended to the surface and EBH4 modified to provide the full density profile on its own from 1000 m. EBH5 was not redeployed.

Mid-Atlantic Ridge Sub-array

The sub-array at the Mid-Atlantic Ridge consists of one full depth mooring MAR1, three shorter moorings MAR0, MAR2 and MAR3, and four landers: two at the site of MAR1, and two at the site of MAR3. MAR0 is a recent addition to the array and consists of five MicroCATs, one current meter and two BPRs to capture the Antarctic Bottom Water (AABW) contribution to the MOC to the west of the ridge. MAR1 provides a full depth density profile through eighteen MicroCATs, with MAR2 acting as a backup to 1000 m on the west of the ridge. MAR3 is sited to the east of the ridge and allows separation of the eastern and western basin MOC contributions.

On Di382, MAR2 was reduced in height by 2500 m to the permeable height of the ridge at 3800 m. MAR3 was extended 500 m to 2000 m so that it extends to the depth at which Argo profiling data are available.

Western Boundary Sub-array

At the western boundary, WB2 is the pivotal mooring and provides a full depth density profile very close to the western boundary wall. WB2 comprises sixteen MicroCATs and eight current meters. WB1 comprises four MicroCATs and four current meters. Inshore of WB1 there is WBADCP (sometimes referred to as WBA) that comprises a Longranger ADCP at a depth of 600 m to measure the shallow Antilles current. East of WB2 is WBH2 consisting of three MicroCATs and five current meters. At the normal offshore extent of the Deep Western Boundary Current (DWBC) is WB4, which comprises fifteen MicroCATs and nine current meters. Further offshore is WB6 comprising five MicroCATs and two bottom pressure recorders, which combined with MAR0 measures the contribution to the MOC of deep water below

5200 m including the AABW. There are again four landers in this sub-array; two at the site of WB2 and two at the site of WB4.

On Di382, the number of MicroCATs on WB1 was reduced from 15 to 4.

In addition to the moorings listed above, the western boundary sub-array also contains three full depth moorings and two landers from the University of Miami, that were serviced on cruise AB1209 on the R/V Endeavor. WB0 comprises three current meters and an upward looking ADCP. WB3 is 22 km east of WB2 and so acts as a critical backup in case of loss of WB2. WB3 consists of 16 MicroCATs, 6 current meters and an ADCP. Combined with the other inshore moorings, it provides the thermal-wind shear and measured velocities from the core of the DWBC. WB5 is located 500 km offshore and is instrumented with seventeen MicroCATs and provides the thermal-wind shear across the full width of the boundary currents including any recirculation.

3.3 Results and Data Policy

All data and data products from this programme are freely available. The NERC data policy may be found at http://www.bodc.ac.uk/projects/uk/rapid/data_policy/. Access to data and data products can be obtained via <http://www.noc.soton.ac.uk/rapidmoc/> (or alternatively <http://www.rapid.ac.uk/rapidmoc>) and <http://www.rsmas.miami.edu/users/mocha/index.htm>). Data may also be obtained directly from <http://www.bodc.ac.uk/>.

4 Computing and Fitted Instrumentation

Zoltan Nemeth, Darren Rayner and David Smeed

4.1 RVS LEVEL C System

Level C - The level C system is a Sun Solaris 10 UNIX Workstation `discovery1`, also known as ABCGATE. The RVS software suite is available on this machine. This suite of software allows the processing, editing and viewing of all data within the RVS data files. This system also has monitors that allow us to ensure that the level C is receiving data from the level B.

4.2 Ifremer Techsas System

The Ifremer data logging system is the system that will eventually replace the existing Level A and B systems while for the most part the Level C will remain as the main system for outputting, viewing and editing the acquired data.

The Techsas software is installed on an industrial based system with a high level of redundancy. The operating system is Red Hat Enterprise Linux Edition Release 3. The system itself logs data on to a RAID 0 disk mirror and is also backed up from the Level C using a 200GB / 400GB LTO 2 Tape Drive. The Techsas interface displays the status of all incoming data streams and provides alerts if the incoming data is lost. The ability exists to broadcast live data across the network via NMEA.

The storage method used for data storage is NetCDF (binary) and also pseudo-NMEA (ASCII). At present there are some issues on some data streams with file consistency between the local and network data sets for the ASCII files. NetCDF is used as the preferred data type as it does not suffer from this issue.

Both Techsas loggers were attached to separate UPS backup devices. Also connected to the KVM switcher.

The Techsas data logging system was used to log the following instruments:

1. Trimble GPS 4000 DS Surveyor (converted to RVS format as `gps_4000`)
2. Chernikeef EM speed log (converted to RVS format as `log_chf`)
3. Ships Gyrocompass (converted to RVS format as `gyro`)
4. Simrad EA500 Precision Echo Sounder `ea500`
5. NMFD Surface-water and Meteorology `surfmet` instrument suite
6. ASHTECH ADU-5 Attitude Determination Unit `gps_ash`
7. NMFD Winch Cable Logging And Monitoring CLAM `winch`
8. Fugro Seastar 9200 G2 XP Differential `gps_g2`
9. Sea-Bird SBE45 MicroTSG

4.3 Fugro Seastar DGPS Receiver

The Fugro Seastar G2 is a Glonass and GPS receiver that is used to provide 10 cm accuracy and also receives differential from the Fugro differential system. This signal is then buffered out to multiple systems including the Trimble 4000 DS. The Seastar was purchased as an upgrade to the old Seastar and G12 combination. The system is designed to cope with the future expected solar activity that is expected to disable part of the existing GPS network. The system is also capable of receiving corrections via internet if necessary.

4.4 Trimble 4000 DS Surveyor

The Trimble 4000DS is a single antenna survey-quality advanced GPS receiver with a main-masthead antenna. It uses differential corrections from the Fugro Seastar unit to produce high quality differential GPS (DGPS) fixes. It is used as the data source for Navigation on the ships display system (SSDS). This antenna is directly on top of the mast and suffers from negligible interference from other items on the mast. It is also almost directly at the centre point of the ship making it an ideal navigation system.

4.5 Ashtech ADU-5

This is a four antenna GPS system that can produce attitude data from the relative positions of each antenna and is used to correct the VMADCP for ship motion. Two antennae are on the Bridge Top and two on the boat deck. The ADU-5 forms part of the `bestnav` system which is an assembly of multiple GPS signals including the `gyronmea` and `emlog` stream in order to calculate the best possible position, speed heading pitch and roll of the ship. The Ashtech is not as reliable as the Fugro Seastar G2 and the 4000DS mainly due to its low position on the ship it is hard for this system to maintain locks on satellites when the ship is maneuvering and the bridge and main mast come into its direct line of sight with the satellites.

4.6 Gyronmea

The Gyronmea is a file that receives its data from the Ships gyro compass located on the bridge. There are two such Gyros on the bridge and we are able to use either one of them as a source of heading. The selected Gyro is logged by the TECHSAS system and is used as part of the `bestnav` calculation.

4.7 RDI 75 kHz Vessel Mounted ADCP

The RDI Ocean Surveyor was setup by the science party at the start of the cruise with a bottom track and water track file that is included with the dataset. The configuration was changed when we left the shelf and went to deeper water. The Ocean surveyors are fed with data from the ships GPS, Gyro and ADU systems

in order so that the system can calculate true speeds and direction of the currents below the ship.

4.8 Chernikeef EM log

The Chernikeef EM log is a 2-axis electromagnetic water speed log. It measures both longitudinal (forward-aft) and transverse (port starboard) ships water speed. The EM log was not calibrated prior to the cruise and was reading at 0.0 knots when alongside.

4.9 Simrad EA500 Precision Echo Sounder (PES)

The PES system was used throughout the cruise, with a variation between use of the Fish and use of the hull transducer. The fish is more accurate than the hull transducer as it is capable of being deployed deeper and is also decoupled from the noise of the ship.

The PES fish was inspected at the start of the cruise. The fairings and clips were replaced where necessary.

4.10 Surfmet System

This is the NMFD surface water and meteorology instrument suite. The surface water component consists of a flow through system with a pumped pickup at approximately 5 m depth. Non-Toxic flow is approximately 25 litres per minute whilst fluorometer and transmissometer flow is approximately 1.4 l/min. Flow to instruments is degassed using a debubbler with 40 l/min inflow and 10 l/min waste flow. During this cruise, the inlet to the debubbler was lowered to between 10 and 15 l/min in order to allow more pressure to another water sampling system. This could have had an effect on the amount of bubbles that built up in the system

The meteorology component consists of a suite of sensors mounted on the foremast at a height of approximately 10 m above the waterline. Parameters measured are wind speed and direction, air temperature, humidity and atmospheric pressure. There is also a pair of optical sensors mounted on gimbals on each side of the ship. These measure total irradiance (TIR) and photo-synthetically active radiation (PAR).

The non-toxic system was enabled as soon as we were far enough away from land. It is also used as a coolant for the container labs. Completely new fluorometer, transmissometer, TSG layout being trialled during the previous cruises. It has proved to be more consistent and accumulating less air bubbles than before. Both transmissometer and fluorometer are mounted in the vertical orientation and the addition of a bleed valve to help remove trapped air from the system. The flow rates and other information labels were added to help identify the direction of flow and the recommended flow rates in each part of the system.

Because the relatively high sea water temperature, the transmissometer optics and the fluorimeter were cleaned once a week. The SBE45 unit was cleaned prior to sailing and not cleaned again during the trip to preserve calibration.

Surfmet rvs stream is the raw data captured from the TECHSAS System

The `temp_h`, `temp_m` and `cond` data in the Surfmet file is a direct copy of the Sea-Bird data however it can be delayed in time. For that reason, always use the data from the Sea-Bird instead of the surfmet for TSG calibrations.

These files contains:

- `temp_h` (Housing Temperature from the SBE45 in the wet lab)
- `temp_m` (Marine Temperature from the Hull intake)
- `cond` (Conductivity from the SBE45 in the wet lab)
- `trans` (Raw Voltage from Transmissometer)
- `fluo` (Raw Voltage from Fluorometer)

- Speed (Wind Speed from Gill Windsonic Anemometer)
- Direct (Wind Direction from Gill Windsonic Anemometer)
- Airtemp (Air Temperature from Vaisala HMP45A)
- Humid (Air Temperature from Vaisala HMP45A)

- Pressure (Air Pressure from Vaisala PTB100)

- PPAR (Photosynthetic Active Radiation from SKE510 PAR Sensor on PORT Gimbal)

- SPAR (Photosynthetic Active Radiation from SKE510 PAR Sensor on STBD Gimbal)

- PTIR (Total Incidental Radiation from CM6B TIR Sensor on PORT Gimbal)

- STIR (Total Incidental Radiation from CM6B TIR Sensor on STBD Gimbal)

Sea-Bird is the raw log of the SBE45 and SBE38 through the SBE45 Junction Box and contains:

- `temp_h` (Housing Temperature of SBE45 TSG)
- `temp_m` (Remote or Marine Temperature from Inlet pipe)
- `cond` (Conductivity in SBE45 TSG)
- `salin` (Calculated Salinity from Instrument)
- `sndspeed` (Calculated Sound Velocity from Instrument)

4.11 Network Services

Networking worked well throughout the cruise despite a few hiccups with one of the wireless access points on the Forecastle Deck.

4.12 Data Storage

DISCOFS is an advanced Network Attached Storage device. All scientific cruise data was stored on this device under the `Disco_Cruises/D382` folder and organised

with a standard template of folders

All CTD, ADCP and LADCP data was backed up to DISCOFS on acquisition.

4.13 Data Backups

Backups of the Level C data were done twice daily as a tar file to LTO tape. Alternating between the standard backup below and a full /rvs backup.

The LTO2 system was backed up on a daily basis in a rolling 2 tape system. Level C Data backup to tape. Using LTO tape on odd, even day schedule. DiscoFS only seems to recognise two external USB hard disks and it doesn't seem to matter which two USB ports.

4.14 Scientific computing and data archive

The Linux workstation, Oceanus, was used for scientific processing and archiving of data. Each of the scientific staff used a Mac to connect to Oceanus via the ships Ethernet or WiFi. The following disks were virtually mounted on Oceanus to enable access to the data on the ships systems:

- CTD directory on the DISCOFS server at /noc/users/pstar/CTD
- ADCP (75 kHz) PC at /noc/users/pstar/adcp75
- Techsas at /noc/users/pstar/NetCDF

Matlab version R2009a was installed on Oceanus and the `mstar` suite of Matlab routines was used to import and process data. Necessary packages for RAPID processing in Matlab are the signal processing, statistics and mapping toolboxes.

There was one power cut during the cruise on 31st October last 40 minutes from 08:01UTC and the workstation had to be restarted when power was restored. Oceanus was connected to UPS following this incident.

On previous cruises problems have been encountered when connecting external hard drives to a Linux workstation and so backups were made to disks connected to a Mac. Backups were made twice daily to one of two external hard drives. The `rsync` command was used to synchronise directories on Oceanus with directories on the external drives and to create a backup of files changed or deleted since the last backup using that disk. A logfile detailing the backup was stored on Oceanus in the directory /noc/users/pstar/cruise/backup_logs, where a copy of the backup script was also kept.

Samba was started on Oceanus to enable read-only access to the files on the local network.

4.15 The RAPID iPad

Di382 saw the first trial of an iPad for mooring operations. There were two main aims of using an iPad: to provide navigation and bathymetry data directly to the aft deck and to complete electronic copies of the mooring logsheets.

Firstly, in previous cruises, it had been necessary for those overseeing deployment of moorings to communicate via radio to the main lab for navigation and bathymetry data. With the use of the iPad, this information was directly available on the aft deck allowing better decision making and communication *in situ*. This information was available via Matlab and via a web application developed on Di382, as described below. This was a very successful use of the iPad.

Secondly, in previous cruises, scanned copies of hand-written logsheets had been included in the cruise report. This rendered them unsearchable in the document and, sometimes, difficult to read. Electronic logsheets were used on the iPad on Di382, as described below. While the finished product was excellent, the software used suffered frequent crashes and the iPad's inaccurate timekeeping was an issue. In future cruises, it is hoped that software will have improved and that Apple will addressed the problem of setting the time accurately on the iPad.

Displaying Navigation Data Using Matlab

The iPad was also used to give more information to the person completing the logsheet on the back deck. An iPad app called Matlab Mobile allows the iPad to link to a Matlab session running on another computer via a local network—in this case a wireless repeater in the hanger allowed the iPad to connect to the ships network, and therefore Matlab session running on the Oceanus workstation. Matlab connector needs to be installed on the host machine and started with the command `connector on`. The iPad app then connects to the host machine by entering the IP address and password if required.

Commands can be run from the iPad Matlab Mobile command line, and a figure window displayed on the host machine is displayed on the iPad. We combined this with the Rapid WIDGIT Matlab scripts to display the waypoint for anchor drop in real-time whilst on the back deck. Unfortunately the Matlab Mobile app does not work well with GUIs and as such some of the information displayed in a normal Rapid WIDGIT window such as the distance and time to target could not be displayed. A couple of Matlab scripts were written that could be run from the Matlab Mobile command line to retrieve this data:

The script, `here.m`, returns the current position, time, uncorrected depth and corrected depth. The script, `there.m`, works when Rapid WIDGIT is running with a waypoint set. It returns the distance to the waypoint, the time to the waypoint, the current speed (as an average of the last 10 minutes to remove spiking), and the ETA in a more easily readable format. `there` can be called as a function with an input argument of speed e.g. `there(10)` calculates the time to the waypoint assuming a fixed speed of 10 knots.

Displaying and accessing navigation information over the ships LAN

Making use of the WiFi network on *RRS Discovery* it is possible to access information in most parts of the ship including the aft deck. Navigation and underway data could be viewed in using the Labview Dashboard app for iOS and Android. The apps access data streamed on `ivs.discovery.local`. This is particularly useful for obtaining the correct time, for example when measuring the range to a mooring.

To aid deployment of moorings a webpage was created showing the distance and time of the ship from the intended mooring locations, water depth and other navigation information. This enabled scientists on the aft deck to better judge the approach to mooring location and the time of anchor drops. A Matlab program on Oceanus created plots saved as PNG files that were displayed on the webpages. The webserver was setup on a Mac as this had PHP installed which enables automatic reloading of web pages. In the future it would be more straightforward to have PHP installed on Oceanus so that it won't be necessary to copy files from one machine to another. The Matlab scripts and instructions for setting up a Webserver are in the directory `rapid_widgit_lite`.

Mooring Logsheets

On Di382, mooring logsheets were completed on the iPad rather than a paper print-out. Below are summarised the steps required to get the logsheets ready and onto the iPad.

1. Logsheets drawn up in MS Word using the mooring diagram as reference
2. Include a table for recording acoustic release interrogation
3. Save (Print) to PDF
4. Open PDF in Adobe Acrobat Professional and add in mooring diagram page, and a notes page
5. Click "Run Form Field Recognition" under the Forms menu
6. Edit any unnecessary fields or insert missing fields ensuring that each has a different name to those already in the document. NB: if multiple fields have the same name, then these will update together if you enter anything in one of them—this can be useful, but not really desired for the logsheets.
7. For recovery logsheets checkboxes were inserted next to the instrument serial numbers so a simple tick could be recorded when checking the serial number.
8. Save the modified PDF and transfer to the iPad
9. For this trip we were using the iPad application "PDFpen" to complete the logsheets, as not only does this allow the use of forms in pdfs, it is also compatible with the TextExpander application. TextExpander allows shortcut text abbreviations to be typed into the compatible application, which then expand into their full format equivalent. For this trip we setup `tttt` to expand to

the current time of the iPad (set to GMT), `dddd` to expand to the current date, and `aaa` and `aar` to expand to “Arm and Arm”, and “Arm and Release” respectively for use when ranging/firing acoustic releases.

10. The form is completed in PDFpen by clicking into form fields and then entering text, or if need be a text box can be added for extra comments. The check boxes are simply ticked or unticked, and a line drawing tool can be used for annotations on the logsheet and mooring diagram.

Problems

The iPad time cannot be set accurately as there is no option for adjusting the seconds. Whilst this may not be a significant problem for normal use it means that care must be taken when recording times for triangulations and anchor drops if the ship is moving. The offset from GMT was recorded on logsheets. The iPad showed drifts of between 20 and 40 seconds regularly.

PDFpen (version 1.3.2) frequently crashed and closed the open logsheet losing any data not saved. This tended to happen if editing a form field that had already been completed and then the text deleted. The subsequent text entry would crash on the third character being entered. To counter the potential loss of data, the forms were frequently saved (by returning to the documents panel within PDFpen). However if this saving was attempted too quickly after text were entered, then that would not be saved instead it was found to be best to wait a short while (5-10 seconds) before attempting to save.

The battery life of the iPad was not as good as hoped and a long day of mooring operations would mean that the iPad had to be plugged in to a socket in the hanger to charge. Its possible the weakness of the wireless network was causing the power to drain faster as the iPad negotiated with the wireless router more frequently, but generally it was sufficient and it was only on long days that it became a problem.

4.16 Updates to Rapid WIDGIT

The zoom operations were modified in the Rapid WIDGIT code as it would frequently zoom to a different area than the one in the display and the user would then have to pan back to the area they were looking at. The code was changed so that instead of using the Matlab zoom functions, the axes limits were adjusted by a factor of two centred on the mid-point of the chart window.

The swath data collected on JC064 at the MAR0 site were included in the bathymetry files that Rapid WIDGIT displays. It is a relatively small area, but when zooming in to the MAR0 site it is now visible.

5 Underway Data Processing and Calibration

Charlotte Mielke, Rafael Jaume-Catany, Alex Clarke and Ben Moat

5.1 Navigation

RRS Discovery has three navigation systems: GPS 4000, GPS Fugro and Ashtech. High quality navigation data is essential for making accurate underway measurements of meteorological parameters. The ships location is necessary to orient measurements in space, while the ships speed and heading are necessary to create absolute measurements of ocean currents and winds that are measured relative to the ships motion.

Navigation data was logged at 1 Hz to the TECHSAS data system. The script `mday_00_get_all.m` creates the files

```
gp4_di382_dDDD_raw.nc (GPS 4000),  
pos_di382_dDDD_raw.nc (GPS Fugro) and  
ash_di382_dDDD_raw.nc (ashtech),
```

where DDD is the julian day of the year. It is then cleaned using the script, `mday_00_clean_all.m`, to create the corresponding `*_edit.nc` files. The edit files for the GPS 4000 and GPS Fugro are then looked at using the `mplxied` script, plotting latitude and longitude to check there were no anomalies in the position, and finally these files are renamed as `gp4_di382_dDDD.nc` and `pos_di382_dDDD.nc`. The script `mapend.m` appends these files daily to `gp4_di382_01.nc` and `pos_di382_01.nc`.

After transferring the heading data from the TECHSAS system to `data/nav/ash` and `data/nav/gyros`, `mgyr_01` is run to remove data that is not monotonic in time. Subsequently, the raw data files are inspected and, if need be, edited with `mplxied`. Then `mash_01` and `mash_02` are run to create the output files. The two scripts clean the data, merge gyro and ashtech data and calculate a smoothed ashtech–gyro correction. The resulting output files, `ash_di382_d<jday>.nc` are then merged to a single output file `ash_di382_01.nc` by using `mapend`. As input, `mapend` requires a text file listing all the individual files to be merged. In this case, the text file can easily be created by typing

```
ls -1 ash_di382_d???*.nc > apend.txt
```

in the `data/ash` directory. Afterwards, `mapend` is called as

```
mapend('ash_di382_01.nc','ash_di382_01','f','apend.txt','/','r');
```

Accuracy of the GPS systems

GPS data from the Ashtech, Fugro and GPS 4000 systems were analysed from day 281 (whilst stationed in port at Southampton) to determine their accuracy. The mean latitude/longitude was calculated and taken away from each data point for

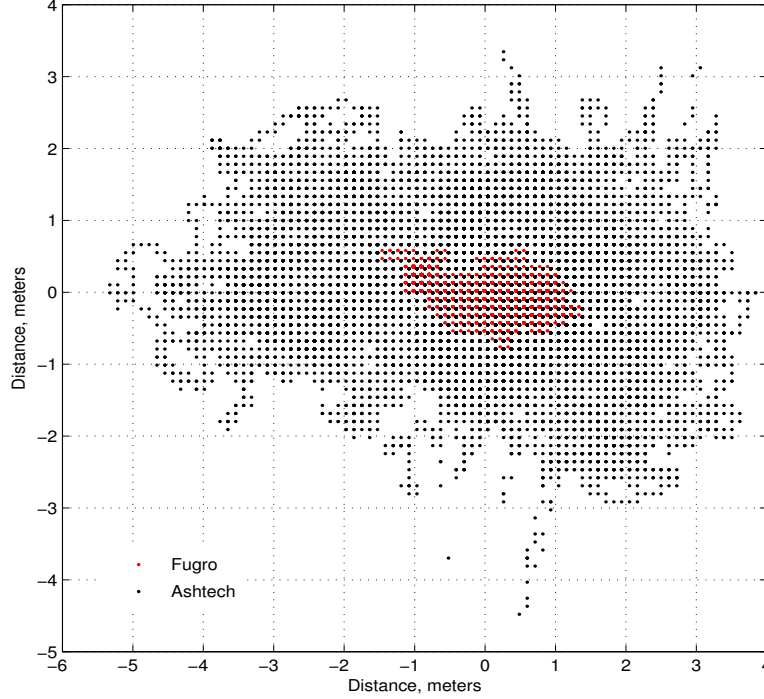


Figure 4: Variation of the Fugro and Ashtech GPS systems whilst in port on day 281. GP4 is not plotted as it is much worse. The standard deviations are: $\text{Ashtech}(x)=1.717\text{m}$, $\text{Ashtech}(y)=1.029\text{m}$, $\text{Fugro}(x)=0.688\text{m}$, $\text{Fugro}(y)=0.218\text{m}$, $\text{GP4}(x)=14.9\text{m}$, $\text{GP4}(y)=10.9\text{m}$

that day. This change in latitude/longitude was converted to a distance in meters and plotted. The standard deviation was deduced for each system. From the results shown in Figure 4, it is clear that the Fugro GPS system is superior to both the Ashtech and the GPS 4000 systems. The GPS 4000 system is not plotted it was shown to be much worse than the other two.

5.2 Bathymetry

A Simrad EA500 hydrographic echosounder is used to obtain bathymetry data throughout the duration of the cruise. A transducer is mounted on the ship's hull, transmitting at 12 kHz. Despite the moorings transducers operating at 10 kHz, the echosounder was occasionally disabled when communicating with moorings on station, hence some gaps appear in the bathymetry data.

RRS Discovery also has a precision echosounding transducer (PES) mounted on a Fish (shown in Figure 5). However, it was inoperable for the first half of the cruise due to broken brackets on the fairing. A fix was implemented and, on the morning of day 314, the fish was deployed, greatly improving bathymetry data for the rest of the cruise. Note that the fish was not used whilst entering port.

The data were gathered assuming a constant sound speed of 1500 m/s and data



Figure 5: The FISH being deployed on the Port side.

was saved to the TECHSAS data system throughout the cruise.

The Matlab script `mday_00_get_all.m` collects the previous day's data from the TECHSAS system, copying it across to Oceanus in the file `sim_di382_dDDD_raw.nc`, where DDD is the Julian day of the year. The script, `mday_00_clean_all.m`, is then run which removes drop outs and unacceptable readings, creating a file

`sim_d382_dDDD_edit.nc.`

This file was then looked at using the `mplxyed` command, where further inconsistencies in the data could be removed by hand on the plot. The hard copy from the live print out was often useful to refer to when cleaning up the data. When finished the output is saved and renamed as `sim_d382_dDDD.nc`.

The script `mmerge_sim_nav_01.m` combines navigation data from GPS Fugro file (`pos_di382_dDDD.nc`) with the bathymetry data. It creates the file

`sim_di382_dDDD_merged.nc,`

which contains the latitude and longitude with the depth. The script also uses the Carter tables to correct the error on the depth due to sound speed variations underwater. Finally, the merged files are appended together in the file `sim_di382_01.nc`, using the script `mapend.m`.

Figure 6 shows the bathymetry data during the steam from Southampton to EBH1.

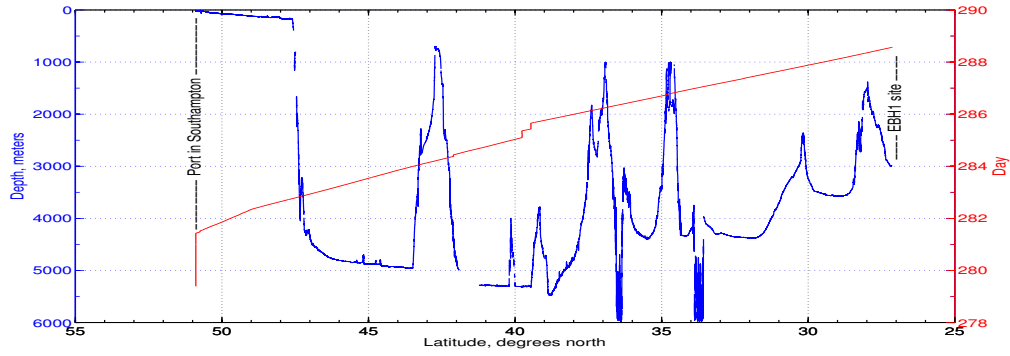


Figure 6: Bathymetry data during the steam from the port of Southampton (50.89 N, 1.40 W) to the site of EBH1 (27.14 N, 15.38 W)

Bathymetry problems

When weather and sea conditions worsened, the data from the EA500 often became unreliable, registering a scatter of more than several thousand meters or having drop outs, and thus making detection of the sea bed impossible. This lead to some sections of bathymetry data being removed, and some sections with large errors on them. On days 311, 310 and 309, large scatters were present. On days 308, 307, 306, 305 and most of 304, no useful data were available. This was directly related to bad weather during these days. On day 305 from 8:00:59 to 8:44:36 the ship suffered a blackout, and so no data is available during this time. During the steam from the mid-Atlantic ridge to Nassau, the echo-sounder had its minimum sea floor depth set at 3000 m. Therefore all data up to 3000 meters was disregarded. This was fixed upon leaving Nassau.

5.3 VMADCP Processing

There are two vessel-mounted Acoustic Doppler Current Profilers (ADCPs) onboard *RRS Discovery* but only the 75 kHz instrument was operational during this cruise. The instrument has a 30-degree beam angle and can either run in narrow-band or broad-band mode. Data were logged on a PC using the software package VmDas. The data were

`cruise/data/vmadcp/di382_os75/rawdata.`

The recording was stopped and restarted once a day. The instrument was configured to sample over two second intervals, with 65 bins each of 16 m distance and a blank distance of 8 m. For most of the cruise, the instrument was run in narrow-band mode and with bottom tracking off. Configuration files for the VMADCP are included in Appendix B.

The final processing was done using the CODAS (Common Ocean Data Access System) suite developed by the University of Hawaii. The individual steps are described in the following sections.

Extracting the data and creating the necessary folders

First, all data of a sequence are moved into a folder `rawdata<sn>`, where `<sn>` denotes the sequence number. Next, a processing directory is created by running

```
adcptree.py di382<sn>nbenx --datatype enx
```

from the `di382_os75` directory. This creates a directory `di382<sn>nbenx` and all the necessary subfolders. A documentation file is also copied to this directory: `adcp_processing.html`.

Initial processing

The initial processing is done by running

```
quick_adcp.py --cntfile q_py<sn>.cnt
```

from the directory `di382<sn>nbenx`. The script, `quick_adcp.py`, is a wrapper that combines several processing steps. In essence, it loads the data into the directory tree, applies some editing and makes an estimate of the water track and, if available, bottom track calibrations. Before running `quick_adcp.py`, it is necessary to create the control file `q_py<sn>.cnt` (Appendix C). Here, only the line

```
--pingtype nb/bb
```

needed to be modified, depending on whether the instrument was running in narrow-band or broad-band mode. If the line

```
--auto
```

is not included, the user will be prompted before each step.

Manual editing with gautoedit

Manual editing was done with the help of `gautoedit`. To run `gautoedit`, it is necessary to go to the `edit` directory, open Matlab and type `codaspaths`. This adds the required paths. `gautoedit` is started by typing `gautoedit`. In `gautoedit`, it is possible to look at the data and manually remove bad profiles and bins. Not much editing was needed for most data on this cruise. All edits are applied by running

```
quick_adcp.py --cntfile q_pyedit.cnt
```

from within `di382<sn>nbenx`.

| Day | Amplitude | | | Phase | | |
|----------|-----------|--------|--------|---------|---------|--------|
| | Mean | Median | Std | Mean | Median | Std |
| 08/10/12 | 0.9953 | 0.9955 | 0.0016 | -3.4411 | -3.4452 | 0.0789 |
| 21/10/12 | 1.0002 | 1.0001 | 0.0010 | -3.3944 | -3.3751 | 0.1278 |

Table 1: Bottom track calibration

Time-dependent heading correction

The first heading correction that needs to be applied is the time-dependent correction of the gyro with a secondary heading source, in this case the Ashtech ADU2 unit. This is done by running `make_g_minus_a(75,<sn>,'enx')` in Matlab. Here, 75 denotes the instrument. Before running `make_g_minus_a`, it is necessary to make sure that an appended heading file that covers the time period in question is available. The rotation angles can be found in `edit/di382<sn>nnx.rot`, and the order of magnitude is typically 1° or less.

Subsequently, `rotate rotate.tmp` is run from a command line within

```
di382<sn>nbenx/cal/rotate.
```

The file `rotate.tmp` has to be modified to contain the line

```
time_angle_file: ../../edit/di382<sn>nnx.rot.
```

The rotation is then applied by running `quick_adcp.py --cntfile ../q_pytvrot.cnt`. The results of the correction can be assessed by having a look at the `*.out` file in either `cal/botmtrk` or `cal/watertrk`.

Fix to `agetmat.m`

The application of the time-dependent heading correction at first caused an error message from `agetmat.m`. The problem was fixed by transposing `corr_heading` in line 836 within the function `get_corrheading` in `agetmat.m`.

Constant heading correction

The second heading correction is a constant correction. It is applied by running `quick_adcp.py --cntfilfe ../q_pyrot.cnt` from within `di382<sn>nbenx`. The angle and phase for the final rotation have to be specified in this file. For this cruise, bottom track data could only be acquired on the first day and on the day we left Santa Cruz.

With this information (Table 1), the following constant rotation was included in `../q_pyrot.cnt`:

```
--rotate_angle -3.42
--rotate_amp 1.00.
```

Creating the output files

After the processing is done, the output data are converted to *.nc files. This is done by running `mcod_01_di346` and `mcod_02_di346`. The first command creates a file `os75_di382<sn>nnx.nc` that contains the ship's position and speed and the measured velocities. The second command creates a file `os75_di382<sn>nnx_spd.nc`, which contains the same variables as `os75_di382<sn>nnx.nc` plus the scalar water speed and the ship speed.

Using `mapend`, output files are then merged into a single file, `os75_di382_nnx_spd.nc`. The first sequence was excluded from the merging as the instrument was running in broadband mode and the file has a different depth axis. The list of files to be appended can be created by typing

```
ls -l di382???nbenx/os75_di382???nnx_spd.nc > apend_adcp.txt
```

in the `di382_os75` directory. `mapend` is then called as

```
mapend('os75_di382_nnx_spd.nc', 'os75_di382_nnx_spd', 'f', ...  
      'apend_adcp.txt', '/', 'r').
```

Missing heading information

After a power failure on 31/10/12, heading information was no longer coming through to VmDAS. This resulted in missing heading information in the .ENX files. For these days, the processing was done using the .ENS files instead.

For the processing of .ENS files, a few things need to be changed. First, `adcptree.py` must be run with the option `--datatype ens`. In `q.py.cnt`, the lines `--datafile_glob *.ENX` and `--datatype enx` must be changed to reflect that .ENS files are used instead of .ENX. Also, the heading alignment of the transducer needs to be known in order to process .ENS files, and it is specified by adding a line `--ens_halign 0` has to be added to `q.py.cnt`. Afterwards, processing could be continued as usual.

The connection was repaired on 06/11/12, and the .ENX files were again used for processing after this date.

Final results and gaps in the data

The most notable gap in the data is from 29/10 to 02/11, due to bad weather, the ADCP was not able to record any good data. All data gaps are summarized in Table 2.

5.4 TSG

During Di382 the near sea surface temperature and salinity were measured all along *RRS Discovery*'s track (Figure 7). The near surface temperature was measured

| Time period (jday) | Reason for missing data |
|--------------------|--|
| 288.8 – 289.4 | ADCP stopped. |
| 291.3 – 294.5 | In port at Santa Cruz. |
| 295.7 – 296.3 | Output .ENX and .ENS files not written (reason unknown). |
| 303.4 – 307.5 | Bad weather. |
| 310.6 – 311.4 | Fixing of missing heading data problem (Section 5.3). |
| 311.7 – 312.5 | Output .ENX and .ENS files not written (reason unknown). |

Table 2: Missing ADCP data

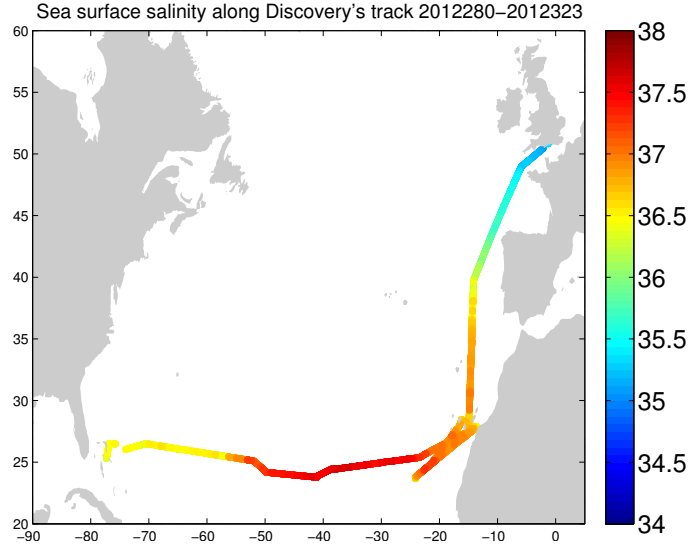


Figure 7: Sea surface salinity measured all along *RRS Discovery*'s track from Southampton (UK) down to the Canary Islands (Spain) to Freeport (The Bahamas)

using a SBE38 probe, located in the forward hold on the starboard side, providing temperature measurements at depths between 6 m and 7 m. Hereafter this temperature will be referred to as remote temperature (`temp_r`) or as sea surface temperature (SST).

The seawater inflow in this ship was located at 0.5 m below the hull (refer to Cunningham (2009) to see a picture). This pumped water is known as the non-toxic supply and was pumped to the wet lab. In the wet lab the non-toxic water passed through an SBE45 MicroTSG to measure the housing temperature or temperature of the water on board (`temp_h`) and the salinity (`tsg_psal`).

To avoid contamination of the non-toxic supply system, the non-toxic water was stopped before any port call. During this cruise, *RRS Discovery* stopped in three different ports. Hence three continuous TSG transects were recorded (Figure 7). Dates (in julian days) of the those three TSG transects were as follow: 1) from 280 to 292 (Southampton-Tenerife); 2) from 295-321 (Tenerife-Nassau): 3) from 322 to 329 (Nassau-Freeport).

During this cruise salinity samples of non-toxic water were collected from the supply in the wet lab every four hours between 8 am and 6 pm (ship time). Samples were kept in individual glass bottles of 200 ml in crates of 24 bottles. When the

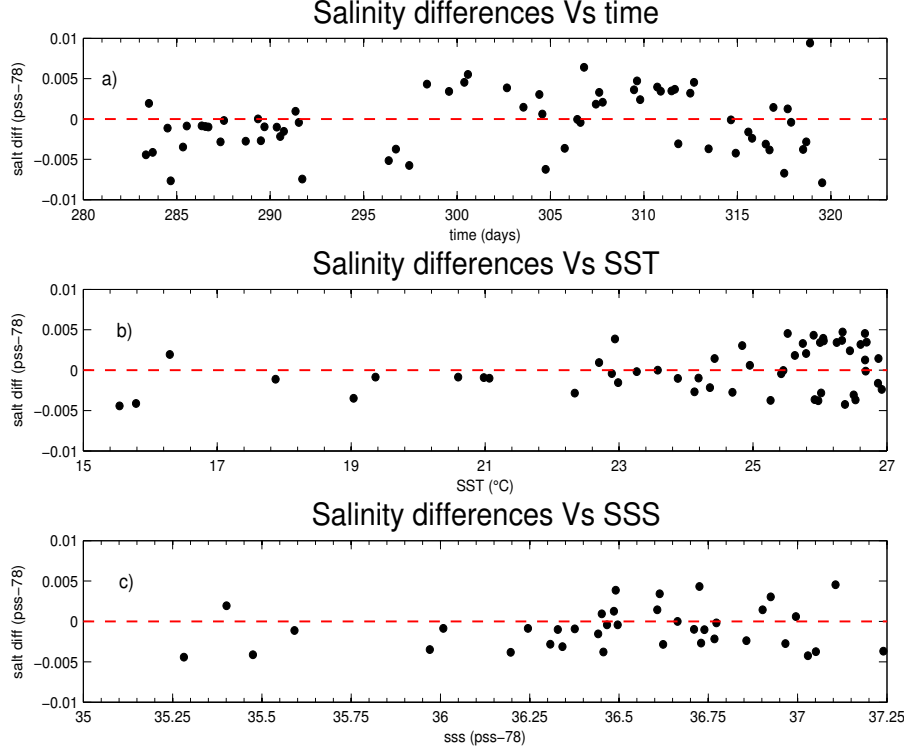


Figure 8: Salinity differences (bottle minus TSG) vs. (a) time, (b) SST, (c) SSS

crate was full, it was kept in the CT lab for 24 hours at constant temperature ($\sim 20^{\circ}\text{C}$) before measuring the salinity with the salinometer. At the end of the cruise, 99 bottles of sea water had been collected and analysed. In addition to the standard `.csv` output of the Autosol, the time in seconds since the start of the year were manually recorded for each sample. These data are read into `mstar` format using `mtsg_01.m`.

As it can be seen in Figure 8 (a), `salt_diff` was generally around zero. The TSG data were stable during all of the transect, therefore it was not necessary to apply any calibration. The `temp_r` was compared to the temperature measured by the CTD (Figure 9) and was stable throughout the cruise with the temperature differences between `temp_r` and `ctd_temp` were generally below 0.025°C . Comparing `temp_diff` obtained from all the CTD casts, only the cast 6 showed a larger `temp_diff` (above 0.25°C and below 0.3°C).

5.5 MET: surfmet, surflight and surftsg

The surface meteorological conditions were measured throughout the cruise. A brief discussion of the performance of the meteorological sensors is given in this section. Figure 10 shows time series of the meteorological data. The *RRS Discovery* was instrumented with a variety of meteorological sensors to measure; air temperature and humidity, atmospheric pressure, short wave radiation, and wind speed and direction. These are logged as part of the SURFMET system. The meteorological instruments were mounted on the ship foremast in order to obtain the best ex-

| Instrument | Calibration Y=C0+C1X+C2X2 | Serial No. | Sensor location | parameter accuracy |
|--|---|-----------------|--------------------------|--|
| SBE45 micro TSG | calibration applied by SBE45 | 231 | Water bottle annex | Temperature: 0.002 °C conductivity: 0.0003 mS/cm salinity: 0.005 psu |
| SBE38 Remote temperature | calibration applied by SBE38 | 416 | Remote Temperature | temperature: ± 0.001 °C |
| Wetlabs Fluorometer | 15.0*(X-0.064) Not applied. | WS3S-134 | Water bottle annex | |
| Wetlabs Transmissometer | Tr = (Vsig - Vdark) / (Vref - Vdark) Vdark = 0.06, Vair = 4.766, Vref=4.658 Not applied | CST-112R | Water bottle annex | |
| Barometer PTB100A | c0=800, c1=52 | F4740025 | foremast | ± 0.25 hPa |
| Viasala HMP45A temperature humidity | c0=-40, c1=100 c1=100 | B4950011 | foremast | temperature: ± 0.2 °C at 20°C humidity: ± 1% at 20°C |
| PAR Skye energy sensor (400–700nm) | c1=1/1.053 c1=1/1.121 | 28556 28559 | foremast PORT STBD | ± 2% |
| TIR Kipp and Zonen CMB6 (335 to 2200nm) | c1=1/0.976 c1=1/1.194 | 962301 47462 | foremast PORT STBD | 0.14×10^{-6} V/W/m ² |
| wind speed Gill wind sonic | speed: c1=50/5 direction: c1=360/5 | 71123 | foremast PORT | speed: ± 2° at 12 m/s direction: ± 3° at 20 m/s |

Table 3: Instrumentation aboard *RRS Discovery* and calibrations applied.

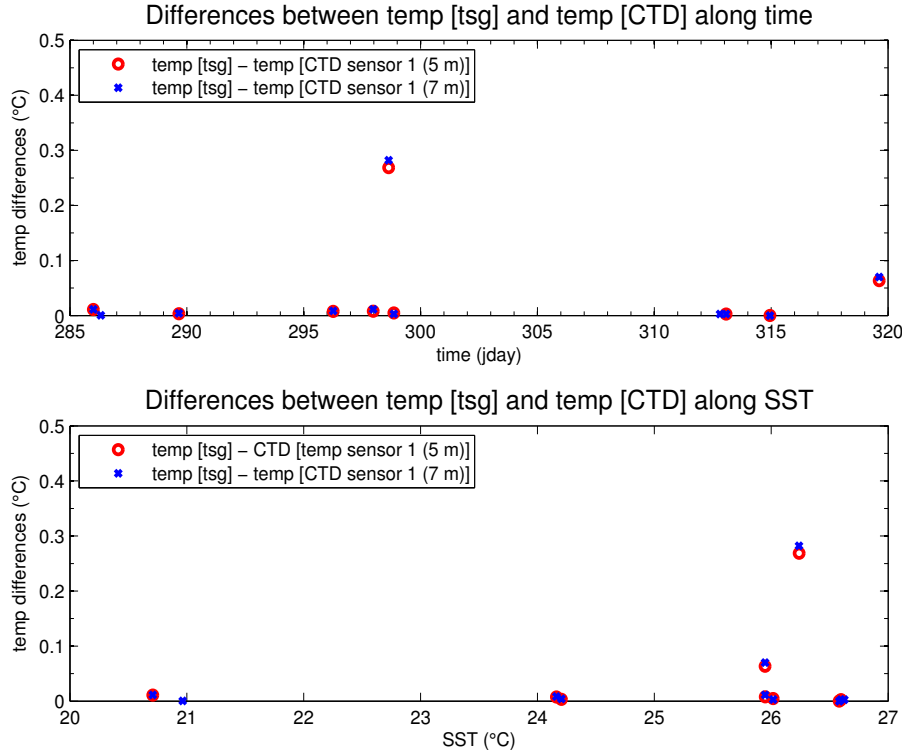


Figure 9: Sea surface temperature differences (TSGCTD)

posure. The heights of the instruments above the foremast platform were: Gill WindSonic anemometer, 1.85 m; Vaisala air temperature and humidity 1.38 m and the irradiance sensors 1.38 m. The foremast platform was 16.16m above the sea surface. Files were transferred from TECHSAS to Oceanus on a daily basis, using the script `mday_00_get_all.m`. The raw SURFMET data files have names of the form `met_di382_dnnn_raw.nc`, where `dnnn` represents the day number. These were copied to `met_di382_dnnn_edit.nc` for editing. The Vaisala air temperature and humidity sensor was located on the port side of the foremast platform. The sensor performed well throughout the cruise. As the ship had only one Vaisala, no conclusions about instrument accuracy can be made. The Gill Windsonic was located on the foremast platform and functioned well throughout the cruise. Again only data from one anemometer was logged so no comparisons with other anemometers could be made.

True wind calculation

When the wind speed is measured from a ship during its sailing, it is necessary consider the sailing speed to get the true wind speed. The true wind was calculated using the true wind subroutine described in Cunningham (2012). The input data required is sourced from the following shipboard instruments whose output was logged in the Techsas system:

- GPS position - GPS Fugro
- Ship's heading - Ships gyro corrected using the Ashtech attitude sensors.

- Measured wind speed and direction - Anemometer readings from the SurfMet instruments

Light

The ship carried two total irradiance sensors, one (PTIR) on the port side of the foremast platform and the other (STIR) on the starboard. A comparison of the TIR short-wave sensors showed that the sensors were in good agreement with a daily mean difference in the measured short-wave values of 4.68 W/m^2 (standard deviation 28.3 W/m^2). In addition to the TIR sensors the ship carried two PAR sensors, which measured down-welling radiation in the wavelength ranges given in Table 3. The two PAR sensors agreed well with a daily mean difference in the measured short-wave values of 1.65 W/m^2 (standard deviation 9.8 W/m^2). It is worth noting that the irradiance sensors need a calibration to be applied to the raw data stream, rather than being applied by the instruments themselves.

Surftsg

Although the `surftsg` data stream was processed all along the cruise Di382, these were not used. Besides transmissivity, all the other parameters are the same as in the TSG data stream. From 10th or 12th November (julian days 315 and 320) the transmissometer showed values of 4.61 V. No further investigation was followed.

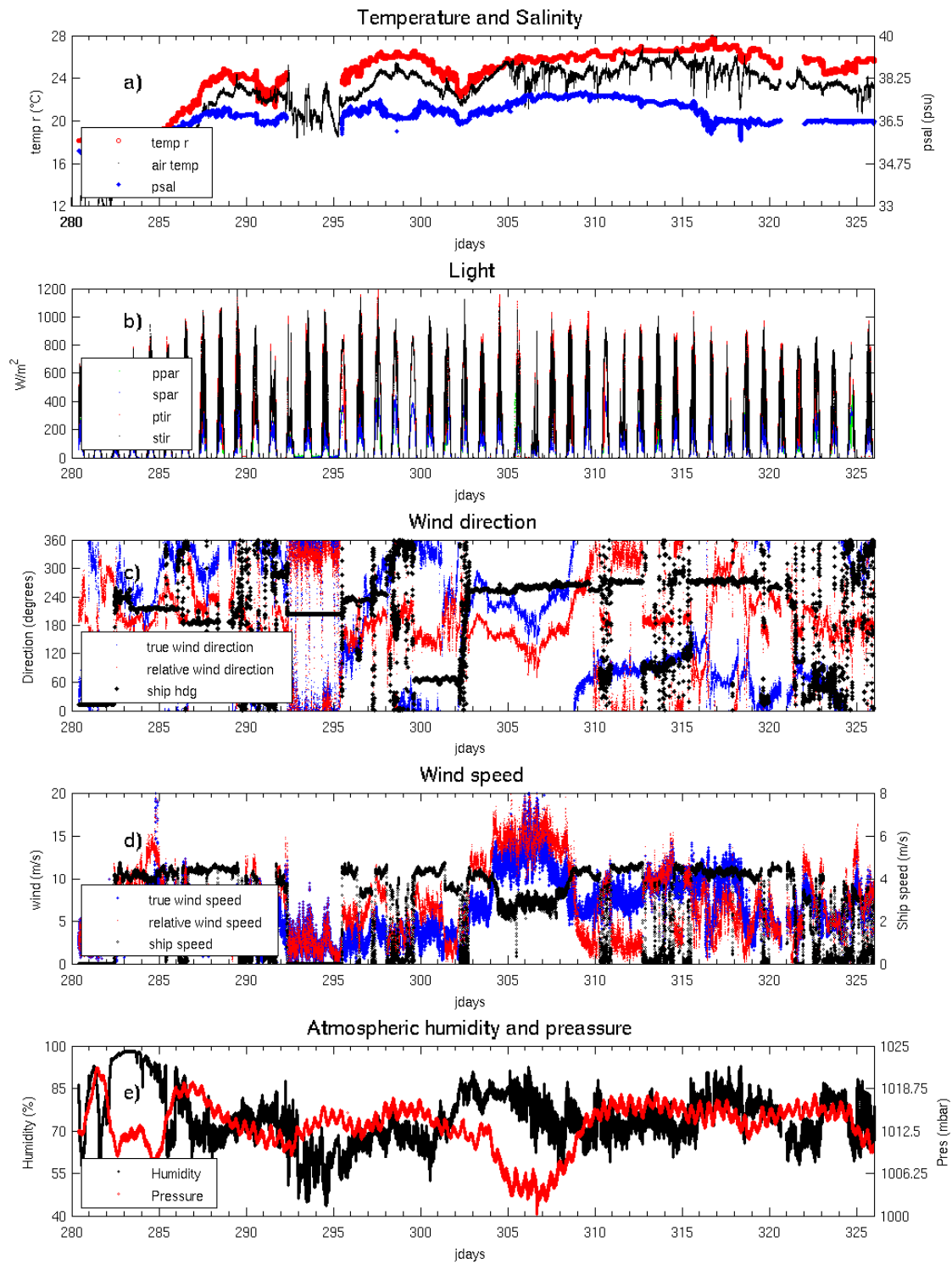


Figure 10: Meteorological parameters measured during the cruise Di382

6 Lowered CTD Operations

Jeff Benson and Paul Provost

6.1 CTD system configuration

1. One CTD system was prepared, with a second system available if required. The first water sampling arrangement was a BAS 24-way stainless steel frame system (s/n S0140171), and the initial sensor configuration was as follows:

Sea-Bird 9plus underwater unit, s/n 09P-46253-0869 Sea-Bird 3P temperature sensor, s/n 03P-5494, Frequency 0 (primary) Sea-Bird 4C conductivity sensor, s/n 04C-3698, Frequency 1 (primary) Digiquartz temperature compensated pressure sensor, s/n 100898, Frequency 2 Sea-Bird 3P temperature sensor, s/n 03P-5495, Frequency 3 (secondary) Sea-Bird 4C conductivity sensor, s/n 04C-3874, Frequency 4 (secondary) Sea-Bird 5T submersible pump, s/n 05T-3085, (primary) Sea-Bird 5T submersible pump, s/n 05T-3088, (secondary) Sea-Bird 32 Carousel 24 position pylon, s/n 32-19817-0243 Sea-Bird 11plus deck unit, s/n 11P-34173-0676

2. The auxiliary input initial sensor configuration was as follows: Benthos PSAA-916T altimeter, s/n 47597 (V2)

3. Additional instruments:

Ocean Test Equipment 10L ES-110B water samplers, s/ns 1A through 12A IOS/NOCS 10 kHz beacon, s/n B3

4. Sea-Bird 9plus configuration file `D382_0869_NMEA.xmlcon` was used for all stainless steel frame CTD casts.

5. The second water sampling arrangement was a NOC/Zubkov 24-way stainless steel frame system (s/n 75313), and the initial sensor configuration was as follows:

Sea-Bird 9plus underwater unit, s/n 09P-34173-0758 Sea-Bird 3P temperature sensor, s/n 03P-4116, Frequency 0 (primary) Sea-Bird 4C conductivity sensor, s/n 04C-2841, Frequency 1 (primary) Digiquartz temperature compensated pressure sensor, s/n 90074, Frequency 2 Sea-Bird 3P temperature sensor, s/n 03P-4872, Frequency 3 (secondary) Sea-Bird 4C conductivity sensor, s/n 04C-3258, Frequency 4 (secondary) Sea-Bird 5T submersible pump, s/n 05T-3090, (primary) Sea-Bird 5T submersible pump, s/n 05T-, (secondary) Sea-Bird 32 Carousel 24 position pylon, s/n 32-53766-0722 Sea-Bird 11plus deck unit, s/n 11P-24680-0589

6. Additional instruments:

Ocean Test Equipment 10L ES-110B water samplers, s/ns 13A through 24A IOS/NOCS 10 kHz beacon, s/n B6

7. Sea-Bird 9plus configuration file `D382_0758_NMEA.xmlcon` was used for all other stainless steel frame CTD casts.

6.2 Other instruments

1. Autosol salinometer. Two salinometers were configured for salinity analysis, and the instrument details are as below:

Guildline Autosol 8400B, s/n 60839, installed in Constant Temperature Laboratory as the primary instrument, bath temperature set point 21C.

Guildline Autosol 8400B, s/n 68958, installed in Constant Temperature Laboratory as the secondary instrument, bath temperature set point 21C.

| Cast | Date | Time hh:mm (GMT) | Lat (°N) | Long (°W) | Max CTD depth (dbar) | Max CTD depth (m) |
|------|------------|------------------------|-------------|--------------|----------------------------|-------------------------|
| 1 | 12/10/2012 | 5:19 | 39.758 | -14.114 | 5111 | 5012 |
| 2 | 12/10/2012 | 12:06 | 39.459 | -14.145 | 5111 | 5012 |
| 3 | 15/10/2012 | 19:46 | 27.126 | -15.403 | 3046 | 3004 |
| 4 | 22/10/2012 | 10:14 | 26.195 | -19.324 | 3762 | 3704 |
| 5 | 24/10/2012 | 3:36 | 23.801 | -24.137 | 4687 | 4607 |
| 6 | 24/10/2012 | 19:33 | 23.689 | -24.134 | 5104 | 5012 |
| 7 | 24/10/2012 | 0:31 | 23.693 | -24.137 | 3557 | 3505 |
| 8 | 07/11/2012 | 23:59 | 24.200 | -49.768 | 5209 | 5114 |
| 9 | 08/11/2012 | 6:12 | 24.204 | -49.766 | 5208 | 5113 |
| 10 | 10/11/2012 | 3:09 | 25.115 | -51.993 | 5623 | 5515 |
| 11 | 14/11/2012 | 19:48 | 26.499 | -70.560 | 5572 | 5465 |
| 12 | 18/11/2012 | 4:36 | 26.477 | -75.851 | 4739 | 4657 |
| 13 | 18/11/2012 | 20:40 | 26.477 | -75.752 | 4681 | 4600 |
| 14 | 19/11/2012 | 1:26 | 26.474 | -75.764 | 3554 | 3501 |
| 15 | 20/11/2012 | 4:20 | 26.517 | -76.700 | 3862 | 3802 |
| 16 | 21/11/2012 | 4:28 | 26.491 | -76.666 | 4670 | 4589 |
| 17 | 22/11/2012 | 0:42 | 26.486 | -76.6731 | 4673 | 4592 |
| 18 | 23/11/2012 | 14:14 | 27.108 | -76.617 | 4065 | 4000 |

Table 4: Deployment information for CTD stations. Positions and times are given when the CTD is at the bottom of the cast.

7 CTD Data Processing

Ben Moat

A total of 18 CTD casts were performed to calibrate the MicroCats and test the acoustic releases. The stations are summarised in Table 4. The variables and units were selected as: time, depth, pressure (dbar), temperature (°C), conductivity (S/m), scan and altimeter. The preferred units for conductivity are mS/m, but the first cast was inadvertently set up to use S/m and was left in these units for the rest of the cruise. The raw data files (`ctd_di382_nnn.bl` and `ctd_di382_nnn.hex`, where `nnn` is the CTD cast number) are converted with Sea-Bird processing software to `ctd_di382_nnn.cnv`, `ctd_di382_nnn.ros` and `ctd_di382_nnn_ctm.cnv`. The data in `ctd_di382_nnn_ctm.cnv` are corrected for cell thermal mass effects using an adaptive filter with `alpha = 0.03` and `tau = 7.0`.

Both conductivity sensors were stable throughout the cruise. However, the difference between the two temperature sensors was about 0.001 to 0.002 °C high in the lowest 2000 m of the casts. This led to a 0.003 offset between the two salinity measurements. In order to identify which of the two sensors was offset the secondary temperature sensor `temp2` was swapped before cast 15. Comparisons of temperature measured from both sensors during cast 15 showed that sensor 1 was the more accurate and was selected as the primary sensor. This new sensor remained on the CTD for casts 15–18.

Attempts to use MicroCAT measurements to discern the better CTD tempera-

| date | crate | CTD Number | start offset | mid offset | end offset | comments |
|-----------|--------|------------|--------------|------------|------------|----------|
| 21-Oct-12 | 97-120 | TSG1 | 0 | 6.00E-06 | 1.80E-05 | P153 |
| 21-Oct-12 | 10 | CTD1/2 | 1.80E-05 | 2.40E-05 | 5.20E-05 | P153 |
| 1-Nov-12 | 49-72 | TSG2 | -6.00E-06 | -2.00E-06 | 8.00E-06 | P153 |
| 1-Nov-12 | 18 | CTD2/3/4 | 8.00E-06 | 1.00E-06 | -9.00E-06 | P153 |
| 1-Nov-12 | 22 | CTD4/5/6 | -9.00E-06 | 6.00E-06 | 1.30E-05 | P153 |
| 12-Nov-12 | 1 | TSG3 | -2.50E-05 | 1.30E-05 | 7.00E-06 | P153 |
| 12-Nov-12 | 11 | CTD6/7/8 | 7.00E-06 | 6.00E-06 | 1.60E-05 | P153 |
| 12-Nov-12 | 19 | CTD8/9/10 | 1.60E-05 | 6.00E-06 | 1.80E-05 | P153 |
| 19-Nov-12 | 21 | CTD10/11 | -6.30E-05 | -3.60E-05 | -4.10E-05 | P153 |
| 19-Nov-12 | 17 | CTD11/12 | -1.30E-05 | -1.50E-05 | -6.00E-06 | P153 |
| 19-Nov-12 | 901 | TSG4 | -6.00E-06 | 9.00E-05 | 6.10E-05 | P153 |
| 19-Nov-12 | 12 | CTD13/14 | -5.20E-05 | 1.20E-05 | 2.50E-05 | P153 |
| 23-Nov-12 | 12 | CTD15/16 | -1.31E-04 | -7.20E-05 | -3.30E-05 | P153 |
| 23-Nov-12 | 17 | CTD17 | -2.80E-05 | / | -1.00E-05 | P153 |

Table 5: Salinometer offset across each crate of samples. The offset applied is measured minus known conductivity of standard seawater.

ture sensor proved unsuccessful. While the MicroCATs are less accurate than the CTD, it was hoped that the higher precision from multiple instruments on each cast would be useful. It was concluded that the cell thermal mass lag in the MicroCATs rendered them not useful for this purpose.

During upcast at CTD station 10 the temperature sensor (`temp1`) reported intermittent measurements at a depth of around 3000 m. The cable to the temperature sensor was replaced before station 11 and performed well thereafter.

Salinometry

A guideline Autosal 8400B Salinometer (s/n: 60839) was used for salinity measurements. A total of 194 salinity samples were taken to calibrate the conductivity sensors on the CTD. The Salinometer was located in the constant temperature laboratory, with the bath temperature set at 21 °C. The ambient air temperature was checked every 4 hours during daylight and varied from 19 to 20 °C. A bespoke Labview was used for recording the conductivity values.

The Salinometer was calibrated against seawater standard before and after each CTD/TSG crate was analyzed. A further standard was run half way through the crate. Standard seawater batch P153 (2K15=1.99958, salinity=34.992) was used throughout the cruise. Table 5 shows the change in the measured conductivity and the known conductivity of the standard seawater sample for each crate.

The processing of salinity data proceeds as follows. Conductivity data from the salinometer are entered into excel files and transferred to the Oceanus in `/ctd/-BOTTLE.SALTS/` as comma-separated value files. The first column of the data must be `ctdnnn_bot`, where `nnn` is the station number (e.g. 001 or 002) and `bot` is the sample number (e.g. 325). This allows for the data for two CTD casts to be saved on the same excel spreadsheet. The last column is entered by hand: it contains

| CTD no | start offset | end offset | offset applied |
|--------|--------------|------------|----------------|
| 1 | 2.40E-05 | 5.20E-05 | 3.80E-05 |
| 2 | 8.00E-06 | 1.00E-06 | 4.50E-06 |
| 3 | 1.00E-05 | -9.00E-06 | -4.00E-06 |
| 4 | -9.00E-06 | 6.00E-06 | -1.50E-06 |
| 5 | 6.00E-06 | 1.30E-05 | 9.50E-06 |
| 6 | 7.00E-06 | 6.00E-06 | 6.50E-06 |
| 7 | 6.00E-06 | 1.60E-05 | 1.10E-05 |
| 8 | 1.60E-05 | 6.00E-06 | 1.10E-05 |
| 9 | 6.00E-06 | 1.80E-05 | 1.20E-05 |
| 10 | -3.60E-05 | -4.10E-05 | -3.85E-05 |
| 11 | -3.60E-05 | -4.10E-05 | -3.85E-05 |
| 12 | -1.30E-05 | -6.00E-06 | -1.13E-05 |
| 13 | -5.20E-05 | 1.20E-05 | 1.20E-05 |
| 14 | 1.20E-05 | 2.50E-05 | 1.85E-05 |
| 15 | -1.31E-04 | -7.20E-05 | -1.02E-04 |
| 16 | -7.20E-05 | -2.20E-05 | -5.25E-05 |
| 17 | -2.80E-05 | -1.00E-05 | -1.90E-05 |

Table 6: Salinometer offset for each CTD cast. The offset applied is measured minus known conductivity. No bottles were processed from cast 18.

the CTD cast followed by the bottle location on the frame (e.g. 105 for bottle in firing position 5 on cast 1). The CSV file contains the conductivity measurement of the standard sea water, which is used to measure the instrument drift. Instrument drift is defined as the difference between the measured standard conductivity and the known conductivity of the standard seawater. This offset is defined in Table 6 and is applied to the conductivities of each cast before the salinity was calculated. The CTD casts were split across crates, which proved problematic in deciding the offset, which should be applied to the measured sample conductivities. This is not recommended for future cruises.

CTD processing and calibration

The CTD casts were processed with `mexec` routines written by Brian King. These routines are higher-level processing programs that depend on the `mstar` library. `mstar` is a replacement for PSTAR, runs in MATLAB and uses NetCDF as its native format. The base directory for CTD processing on Oceanus is `cruise/data/ctd/`. The `mexec` routines were run in the order given in Appendix B.2.

The CTD conductivity measurements were calibrated against bottle samples measured using a Salinometer. Trends with pressure and time were observed in the differences between the measured conductivities (sensor 1 and sensor 2) and the bottle conductivity. Figure 11 shows the steady increase in time of the CTD conductivity relative to bottle conductivity for sensor 1 and sensor 2. A linear regression was fitted through the more stable periods of each sensor, i.e. seven measurements the period between sample 40 and 50, and the data between 6 and 13 were excluded from the regression. The difference between the two regressions

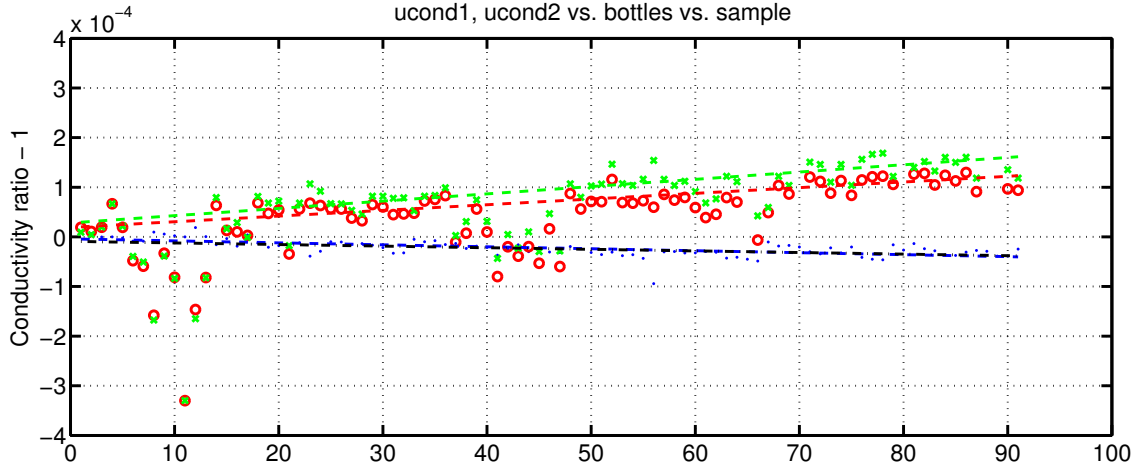


Figure 11: Conductivity ratio between `cond1` and bottle salinities (green), conductivity ratio between `cond2` and bottle salinities (red) and conductivity ratio between `cond1` and `cond2` (blue). All ratios have had 1 subtracted due to the small scaling around unity. The green and red dashed lines are based on regions where the Autosal was stable: sample numbers 1:3, 18:36, 48:60, 68:88. This was decided to be representative of the real drift of the CTD sensors. The blue dashed line is a fit to the drift between the two CTD sensors. The black dashed line is the difference between the green and red lines. The black and blue lines overlying one another gives confidence to the fact that the real drift of the CTD sensors has been captured.

agrees well with the drift between the two conductivity sensors (blue lines) giving us confidence in using a time dependent calibration to correct the conductivity.

A multiplicative conductivity correction for the time drift of the two sensors was derived. This was applied to both conductivity sensors for each station using `ctd_calibrate_di382`. The correction was applied to the 24 Hz file and the salinities were recalculated. After this time drift correction was applied a correction for pressure was not required. The time drift correction applied as single multiplicative factor for each station. The calibration lowered the conductivity by $8.6914\text{E-}06$ for the primary sensor for each successive station. The calibration lowered the conductivity by $1.11259\text{E-}05$ for the secondary sensor for each successive station.

8 Mooring Operations

Rob McLachlan

The mooring operations carried out can be split in to three sections:

1. Winch deployments
2. Hand deployments
3. Recoveries

8.1 Winch deployments

This method uses the double barrel winch system; this allows the wires/ropes to pass around the double barrels four times before either going round a diverter sheave and on to a reeling winch or directly on to one of the reeling winches. The reeling winches store the wires/ropes under a constant, relatively low tension. The wires/ropes are wound on to the winch prior to deployment ensuring all the shackles, links and joins are wrapped in canvas or similar. The start of the wire is passed through the scrolling of the reeling winch, around the double barrel four times, under a deck sheave and finally through a block hanging from one of the aft cranes. From here the wire/rope is connected in to whatever is at the top of the mooring. Deployment starts when the run in length has been determined taking into account the prevailing weather, surface currents and previous experience. It is normal to start deployments with the vessel moving ahead at between 0.5 and 1.5 knots, this allows the deployment to start without too much outboard tension and gets things underway steadily. The speed can be increased when necessary. When deploying large buoys and packages the second aft crane can be used to pick this up using a release hook and deployed over the aft ensuring that there is enough slack in the wire/rope from the winch to prevent snatching. Connecting buoyancy packages, such as packs of glass spheres, and instrumentation requires the use of a deck stopper to transfer the load from the winch to the deck so that the buoyancy/instrument can be shackled in line and seized using cable ties. The load is then transferred back to the winch and deployment commences. Attaching instruments that clamp on to the wire does not require the use of the deck stopper and can be done while the wire is under tension. The mooring deployment continues as described, stopping off to deck to connect buoyancy and instrumentation and clamping on instrumentation as required until the bottom of the last wire is reached, this is then stopped off to the deck and the releases, chain, shock rope (if used) and anchor is connected in. The load is then transferred to a slip rope; this is a length of rope attached to an eye bolt in the deck and then a few turns taken around it and a link on the chain. When the deployment position is reached the anchor is lifted over the aft using a release hook in the aft crane or attached to a wire from a suitable deck winch, the slip rope is then used to transfer the load to the anchor by slipping out slowly, the anchor is lowered in to the sea and then released. The ship then repositions and the release deck unit can be used in conjunction with a transducer to communicate with the releases and confirm that the mooring is descending and reaches the bottom.

8.2 Hand deployments

This method does not require the use of the winch due to the short lengths and relative lightness of the mooring components. This type of deployment is normally reserved for the shorter polyester rope moorings and the Landers. For the polyester rope moorings the ropes are coiled in to baskets ensuring that both ends of the rope are accessible. For Lander deployments the ropes are coiled on the deck due to the very short lengths. The buoyancy, instrumentation and ropes are then all shackled together and seized with cable ties. Any clamp on instrumentation is then clamped on. The mooring is then shackled in to the releases and finally the anchor, or if it has a Lander frame then this is shackled in. One of the aft cranes is the attached to the anchor/Lander frame with the release hook ready for deployment. Deployment starts when the run in length has been determined taking into account the prevailing weather, surface currents and previous experience. It is normal to start deployments with the vessel moving ahead at around 0.5 knots, this allows the deployment to start without too much outboard tension and gets things underway steadily. The speed can be increased when necessary. The mooring deployment starts by lowering buoyancy/instrumentation in to the water by two or more people and then feeding out the rope as required, this continues until all of the buoyancy and instrumentation is deployed. When the deployment position is reached the anchor/Lander frame is then lifted over and lowered in to the sea and the released. The ship then repositions and the release deck unit can be used in conjunction with a transducer to communicate with the releases and confirm that the mooring is descending and reaches the bottom.

8.3 Recoveries

Before the recovery is attempted the deck and associated machinery needs to be ready for such operations; a recovery line needs to be attached to the double barrel winch system, through a block on the aft crane and round to the starboard side from where recoveries will be attempted. A deck stopper needs to be ready. Any tools need to be at hand. Recovery of a mooring starts with attempting to communicate with the releases using the deck unit and the transducer. Once communication has been established the release command can be sent and the mooring released from its anchor. As the mooring begins to surface the lay of the mooring on the surface can be established, this is particularly important for the longer moorings and often requires that all of the mooring is on the surface before a decision is made to move in for recovery. Once the decision has been made to move in the ship creeps towards the mooring aiming for the top recovery float in such a way that the mooring can be streamed aft of the vessel once the recovery float and line has been secured to the vessel. As the ship approaches the recovery float, ensuring that the starboard side is lined up with the float, a grapnel is thrown out in an attempt to hook the recovery line/rope. Once hooked, the line and buoy are hauled on board by hand, the buoy is removed and the recovery line is attached to the line that has been routed from the winch. The vessel then repositions so that the mooring is streaming aft, at the same time the mooring is being slowly hauled on board using the winch. Once everyone is happy that the mooring is streaming aft, that the tension is fine and that the vessel

is moving at the correct speed then the mooring recovery can commence by hauling in on the winch. Stopping off to the deck stopper is required to transfer the load of the mooring from the winch to the deck in order to remove buoyancy packages and instrumentation. Clamp on instrumentation can be removed while the tension is still on the mooring without the need to stop off to deck. Often, for large buoyancy spheres or for the recovery of the Landers, the crane can be used to slew these items in board.

9 Mooring Instrumentation and Data Processing

Darren Rayner, Alex Clarke and David Smeed

9.1 MicroCATs

A total of 131 Sea-Bird SMP-37/IMP-37 MicroCAT CTDs were recovered from 16 moorings. The two instrument types (SMP/IMP) differ in their communication modes for programming and data retrieval being serial and inductive respectively. These are pumped CTDs with a temperature specification (initial accuracy: stability: resolution) of 2 m°C: 0.02 m°C/month: 0.01 m°C; conductivity specification 0.003 mS/cm: 0.003 mS/cm/month: 0.0001 mS/cm and; Pressure specification of 0.1% full-scale: 0.05% of full scale range per year: 0.002% of full scale range. Almost all of them are rated for use at 7000 m but 4 are rated to 3500 m only. The CTD instruments are fitted with one of three types of pressure sensor: Druck; Paine and; Kistler. The pressure sensors differ in their characteristics and the order of quality is Kistler, Druck and Paine, where the Paine is close to the specification above but typically has worse stability than quoted. The full scale for pressure is also different for the three pressure sensors but is around 7000 dbar.

Each instrument on recovery is downloaded using Sea-Bird Seaterm software appropriate to the firmware version of the SMPs. The IMPs (S/N less than 7000) are downloaded in HEX using our own software that allows multiple downloading of IMP instruments and is considerably quicker than the Sea-Bird software: the HEX files are subsequently converted to ascii format.

Subsequent to data download the instruments are then prepared for calibration. Calibration consists of lowering the instruments with the shipboard CTD. A comparison is then made between the microCATs and the shipboard CTD, using data from five minute stops on the CTD upcast, made at 12 depths throughout the water column. This provides a post mooring deployment calibration of each MicroCAT CTD sensor. The same calibration procedure is adopted for instruments to be deployed. By this method we obtain *in situ* pre and post deployment calibrations that can correct for sensor drift during their deployment. The pre deployment calibration also serves as a function test of the instrument. During the cruise 156 microCATs were lowered on 13 CTD casts.

For mooring deployments the microCATs sample once every 60 minutes and for calibration cast once every 10 seconds (their highest sampling rate).

Raw ASCII microCAT data are collected together on Oceanus for subsequent processing.

Processing

The RAPID-MOC/MOCHA project uses instruments from a number of different manufacturers and measurements utilised by three science teams within the project. At the outset we adopted a common data format, to which we ensure all instrument

data conform. The format is ascii and is referred to as RODB and the processing software is MATLAB. The programmes utilised are:

- `mc_call_2_d382.m` : Performs stage 1 processing, converting microCAT raw ascii data to the common RODB format.
- `microcat_raw2use_003.m` : Performs stage 2 processing, eliminating data at mooring launch and recovery; interpolates data gaps; saves file; creates diagnostic plots.
- `mc_call_caldip_d382_v3.m` : Plots all microCAT data from one CTD cast with the CTD data. Used during the cruise for a function check of the microCATS, and a qualitative assessment of sensor performance and post cruise provides quantified calibration information.

Calibration Dips

A Matlab program `m_caldip_check_d382` was written during the cruise to provide a quick quantitative comparison of MicroCAT cal-dip data with the Sea-Bird 911 data from the CTD. Data obtained during the middle part of the deepest bottle stop was used. For each instrument differences of conductivity, temperature and pressure between the instrument and the CTD sensor were calculated. Typically there were between 20 and 100 samples depending on whether acoustic releases were tested during the bottle stop. The mean and standard deviation of the differences for each instrument are then presented in a table.

Between 12 and 18 MicroCATs were deployed on each CTD cast. Outliers for each cast were identified as being those MicroCATs for which the mean difference from the CTD differed from the average the mean difference for instruments on that cast by more than 2.32 standard deviations of the mean differences (For a normal distribution 98% of samples lie within 2.32 standard deviations of the mean). Similarly instruments with unusually high variability were also identified by the comparing the standard deviation for each instrument with the distribution of standard deviations for that cast.

MicroCAT problems

In addition to the MicroCATs that were deemed to have calibration offsets that were too large [[details in the calibration dip section]] there were some other problems encountered with the MicroCATs.

A new version of the SeaTerm V2 software that was installed on the new download laptops has a different process for converting `.xml` files to the required `.cnv` files. Now the output variables need to be selected, along with the units, and the order in which they are written to the file also needs to be specified. These settings can be saved as a default to future use with the software, but for reference the order should be: Temperature in TS-90°C, Conductivity in S/m, Pressure in dbar, Time in "Time, Instrument (seconds)". This will then match the previous format and the stage 1 routines can handle these datafiles.

Serial number 3270 exhibited a very large over-reading of pressure on the pre-deployment cal-dip (1600-2000 dbar over-reading). This instrument was fine on it's last dip aboard cruise RB1201 (where it was dipped but not deployed) so it has drifted a lot since then. The last calibration was in January 2012 following a pressure sensor upgrade. Sea-Bird were contacted and they suspect there is a drift in the slope of the pressure calibration and as such the pressure sensor needs to be replaced.

Serial number 5246 was likewise reading incorrectly for pressure (up to 80 dbar at 3700 m). This instrument has never performed within specification since the pressure sensor was replaced in 2010. Sea-Bird were contacted and they are to replace the pressure sensor under warranty.

3258 flooded on EBH4. The bulkhead connector was broken and appears to be the source of the flooding.

The data record from serial number 5485 recovered from MAR1 exhibits a sudden drop in conductivity of about 7 mS/cm. This is typically symptomatic of something falling into the conductivity cell, but this instrument should have been deployed with the cell opening pointing down as it has a bleed hole to allow air to escape the other end. Therefore it's not clear if it is fouling that has caused the problem. The conductivity sensor was also under-reading on the post recovery cal-dip. The cell was attempted to be cleaned and re-dipped but it again was under-reading. This instrument needs further examination.

Serial number 4799 has a faulty pump as evidenced by the slow response of the conductivity sensor on cal-dips. This needs to be repaired.

MicroCAT serial number 6333 had some random data in the middle of the record where it appears that the instrument failed to write to the memory but increased the sample number count. There is therefore approximately 4.5 hours of data missing. On resumption after the missing data, the sampling timebase also changes, with the data prior to the gap being collected on 1 second past the hour (and 1 second past 30 minutes), but the data after the gap was collected on 34 seconds past the hour (and 34 seconds past 30 minutes). This instrument also caused problems after the cal-dip where it got into a command state where it would not communicate properly. Commands could be entered if they were typed sufficiently quickly after waking the instrument with the return key, but if not then they were not recognized. Although there were no indications of a flat battery from the DS reply the batteries were changed and this seems to have fixed the problem of the communication. However this instrument again collected a period of bad data where it again seems not to have written to the memory but incremented the sample count. This instrument needs further investigation.

9.2 Bottom Pressure Recorders

Bottom pressure recorders (BPR's) are deployed on landers (see figure 12), which sit on the sea floor directly attached to the anchor frame itself. They record the pressure and temperature once every 30 minutes throughout their lifetime. Due to their weight, 8-10 glass buoyancy spheres are usually placed directly above the BPR's. Enough buoyancy redundancy is given such that if any part of the mooring

| Di382 | Inst code | Number | Directory |
|------------------|-----------|--------|-----------|
| InterOcean S4 | 302 | 3 | s4 |
| Aanderaa RCM11 | 310 | 8 | rcm |
| RDI ADCP | 324 | 1 | adcp |
| Seabird Microcat | 337 | 131 | microcat |
| Sontek Argonaut | 366 | 6 | arg |
| Nortek Aquadop | 370 | 23 | nor |
| Seabird Seagauge | 465 | 18 | seaguage |
| Total | | 190 | |

Table 7: Summary of moored instrumentation on Di382.

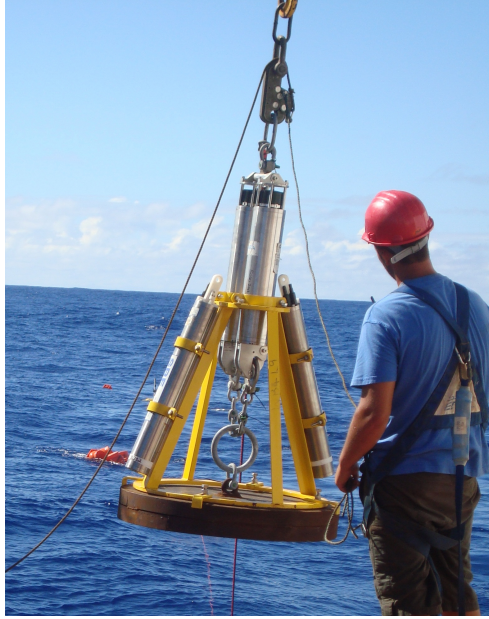


Figure 12: Lander WB4-L9 being deployed from the aft deck.

should break, or if a number of glass spheres implode (up to a certain limit), there is still enough buoyancy left to float the mooring to the surface. BPR's are deployed in pairs, which not only gives the extra data, but more importantly gives redundancy if one should fail or flood. During this cruise the BPR on EB1L7 (serial number 0061) flooded. RAPID uses the Sea-Bird SBE26 Seagauge and/or the Sea-Bird SBE53 BPR to measure bottom pressure and temperature. The data is processed in three stages.

Stage 0

The raw data is downloaded from the BPR using Sea-Bird's software and saved as `.hex` file. These are converted to `.tid` files using the same software. After downloading the files are transferred to the seagauge directory in `/raw/d382` under files names based on the serial number of the BPR recovered. An `info.dat` file is also created which contains information about the moorings location, the start and end times, and serial numbers.

Stage 1

The code `seagauge2rdb_003.m` looks at the `info.dat` file and converts the ASCII `.tid` file to RODB format. The units are converted from psi to dbar, the median temperature and pressure are calculated, and if there is a set clock offset from GMT recorded, this is applied as well. There is an option to correct for wrapped data, however this was not necessary on Di382 cruise. A file, `stage1_log`, is created which records the options chosen by the processing operator when running this code. The code is located in

`/data/exec/d382/stage1/bpr/seagauge2rdb_003.m.`

Output files are saved in `data/moor/proc/(mooring I.D)/seagauge/` with file names ending in `.raw`. A postscript figure is also created of the raw data, under the filename ending in `.raw.eps`.

Stage 2

The BPR's pressure measurements have a drift associated with them over their lifetime, usually of an exponential-linear nature. Stage 2 consists of removing these drifts and correcting the linear clock offset in the data. The code `seagauge_processing_d382_003.m` is run (which also calls `purge_bp_003.m`), which first corrects the clock drift, and then temporarily applies a 2 day low pass filter to remove daily tides. A straight linear fit is calculated of the form,

$$g(t) = a_3(t - t_1) + a_4 \quad (1)$$

and an exponential plus linear fit is calculated of the form,

$$f(t) = a_1 \left(1 - \exp[-a_2(t - t_1)] \right) + g(t) \quad (2)$$

With the daily tides removed the user can check the exponential-linear fit by eye to ensure it is sensible. The linear fit is not used. By taking the inverse of the decay rate a_2 , we get the decay scale, which typically has the value of tens of days. At this stage two figures are saved; the first is with the raw temperature and pressure data, with the file ending in `.use.1.eps`. The second figure (ending in `.use.2.eps`) shows three plots of the data with the 2 day low pass filter applied. The first plot is of the pressure with exponential-linear fit, the second plot is of the pressure with this exponential-linear drift subtracted, and the third plot is of the temperature. The BPR data is then saved with the exponential-linear drift subtracted (but without the two day low pass filter) as a file ending in `.use`.

Stage 3

The final stage of BPR processing uses the code `bp_stage3_d382.m`. This removes daily, fortnightly and monthly tides. The file `stage3_log` keeps a track of the parameters used, and the final output file saved ends in `.seagauge`.

BPR problems

SBE26 serial number 393 would not communicate. This instrument was loaded at NOCS prior to the cruise, so this needs further investigation. SBE53 serial number 0061 flooded on EB1L7 and needs returning to Sea-Bird for repair. Serial number 0064 recovered from EBH1L7 was found to have a time offset of 1 hour, 1 minute and 7 seconds from GMT, but when comparing with the data from 0060 on the same mooring it is evident that serial number 0064 had the time incorrectly set by 1 hour on the deployment cruise. This offset is entered in the `clock_offset.dat` file in the cruise raw data directory and corrected during processing. The BPR records from WBAL2 showed two clear jumps where the mooring moved slightly downslope. This was probably caused by an anchor that is slightly lighter than that required for the strong currents at this site.

Lander mechanical problems

We nearly lost the lander frame and BPRs from the recovered WBAL2 as the releases almost slipped out of the frame on recovery. It looks like corrosion of the clamps through contact with the stainless bolts has caused the tension to drop off and allow the releases to move slightly. This is the shallowest lander site in relatively fast flowing warm water and so corrosion is probably fast than at other lander sites. There was also strong evidence of crevice corrosion on the acoustic releases recovered from the EBH4L2 lander where the clamps were tight against the release pressure housing. In light of the losses of the lander frames from MAR0 and MAR1L6 and the two corrosion problems detailed above, the lander designs needs revision.

9.3 Current Meter and ADCP Processing

All current meters recovered on this cruise were processed as per previous cruises using the Matlab stage 1 and stage 2 processing routines. A total of 40 current meters were recovered, consisting of seven Aanderaa RCM11s, six Sontek Argonaut MDs, three InterOcean S4s and 24 Nortek Aquadopps. A number of these had short records due to a combination of premature battery depletion and beam failures causing the currents data to be invalid. Full details of instrument record lengths are shown in Table 14

Beam failures were limited to the Sontek Argonaut MDs, with four out of six having a beam failure during the deployment period. As this is sometimes not obvious from the output velocity plots from the stage 2 processing (especially when viewing the filtered data) the stage 2 routine was modified to also produce plots of the diagnostic data available to highlight periods of invalid data. The diagnostic information available is the *u*, *v* and *w* velocity component standard deviation, along with the signal strength, noise level and resultant signal to noise ratio for each of the three beams. These plots are now automatically saved to the same output directory as the `.use` data files and `.use.eps` graphics files.

Two of the S4s recovered on this trip (serial numbers 35612572 from MAR1 and 35612571 from MAR2) were incorrectly setup to only log channel 6 rather

than channels 2, 3, 4, 5 and 6. This can be caused by the instrument being setup via a terminal and the command CA2,3,4,5,6 being instead entered as CA23456. There are therefore no heading, conductivity or temperature measurements from these instruments. The VB routines used to download and convert the S4 data were modified so that it would be able to handle instances of varying numbers of ancillary channels, and this updated set of routines were recompiled to create `S4download.V3.exe` and installed on the instrument download laptops.

Current meter problems

Sontek Argonaut MD serial number D332 not only had a beam failure after 8 days of the deployment, it also had a constant temperature reading of -10°C indicating that the temperature sensor is faulty. This could have a knock on effect on the speed of sound calculation as the instrument uses the measured temperature to calculate the speed of sound, however this should be corrected in the stage 3 processing.

Beam failures also occurred in Sontek serial numbers D273 (from EB1), D278 (from EBH5) and D295 (from MAR1).

Several of the Sonteks also stopped early due to flat batteries. The battery endurance calculations suggest this shouldn't have been a problem for the sampling setup we have been using, but with the new switch to an 18-month service interval, the sampling frequency has also been reduced to allow the sampling to continue for longer.

The battery in RCM11 serial number 303 depleted approximately 13 days early. As with the Sonteks, the sampling frequency of the RCM11s has now been reduced as the project moves to an 18-month service interval.

The data from RCM11 serial number 305 needed a lot of manual editing towards the end of the record where it was missing the reference channel reading at the start of each sample. The instrument also stopped early, which after consultation with Aanderraa has been diagnosed as likely being due to a flat battery. Initially it looked like a different problem as the number of words on the DSU was seen to visibly drop when the DSU Reader cable was connected, leading us to think that a memory pointer had been changed, but Aanderaa suggested that it was the battery causing the problem.

The S4 recovered from MAR2 (serial number 35612571) has a faulty pressure sensor.

Several of the Nortek current meters appear to have not had the pressure sensor correctly zeroed during setup. This can at worst lead to zeroes throughout the timeseries as the instrument doesn't reach the depth range that the sensor thinks is zero, but more commonly the pressure is simply offset from what it should be. Each affected current meter can be corrected by using the pressure record of MicroCAT CTDs that were deployed at the same nominal depth, but for those on WBH2 there are not always corresponding MicroCATs so the correct pressure needs to be worked out using the length of rope between the different instruments and using that as an additional offset.

Nortek serial number 5963 had a corroded bulkhead connector pin which had snapped off and become stuck in the bulkhead connector. This instrument needed

to be downloaded using the end cap from another instrument.

9.4 WBP1 PIES

A recovered lander frame was modified to fit a PIES so that it could be deployed at the new WBP1 site approximately 40 nautical miles to the north of WB2.

The PIES was setup with the following parameters for deployment in 4100 m of water.

Serial Number: 136

Mission Statement: WBP1 deployed 2012 from Disco's Last Dance Di382.

Travel Time Measurements: 24 pings every 60 minutes

Pressure and Temperature measured every 60 minutes

Pressure & temperature frequency file disabled

Telemetry data file enabled

Estimated Water Depth: 4100 meters

Acoustic Lockout: 4.92 seconds

Acoustic output set at 191 dB

Current Time: Fri Nov 23 10:24:51 2012

Release Time: Fri Nov 22 02:00:00 2019

Commands: CLEAR 76

TELEM 65

XPND 69

BEACON 73

RELEASE 8

Testing during setup confirmed the correct operation of the pressure sensor and responses to the XPND, BEACON and RELEASE commands. There was difficulty in getting the instrument to acknowledge the CLEAR command as seen when trying to switch off the BEACON mode. Following deployment the instrument was monitored to the seabed by ranging in the XPND mode. However no further tests could be conducted as a final CTD was taking place and the pinger had not been removed from the frame. The CLEAR command again could not be acknowledged but it is unclear whether this was due to interference from the pinger, or the same problem experienced in the lab prior to deployment. If in the future the data telemetry option is required then it would be wise to do this without putting the instrument into any other command mode as the CLEAR may still not be able to be acknowledged. This may also be important for when attempting recovery as the RELEASE command may not be able to be received if in another mode than cannot be cancelled until the instrument reaches midnight.

10 Float and Drifter Deployments

Rafael Jaume-Catany

10.1 Argo float deployments

The international Argo project consists of an array of about 3000 floats distributed all around the global ocean. Argo floats profile every ten days and provide observations of temperature, conductivity and pressure in the water column, from the surface down to 2000 m. The spatial resolution of the array depends on the number of the number of the floats which are operational at any given time. At the moment the spatial resolution of the array is estimated to be about 3 degrees (<http://www.argo.ucsd.edu/http://www.argo.ucsd.edu/>). As part of the UK's commitment to the Argo programme, five floats were deployed during Di382 (Table 8). The choice of the deployment location was made looking at the largest gaps of floats near by the scheduled ship's transect.

Before each float was deployed, this was connected to a serial port of a laptop using the communication cables supplied by the fabricant. Then the recommended pre-deployment test was run using TeraTerm (baud rate: 9600, 8 data bits, no parity, 1 stop bit). To complete the pre-deployment test takes between 15 and 20 min. This test includes a full check of, and if necessary, adjustment of float time (one float had a year set to 1972), satellite transmission, pump inflation, pressure test, battery voltage, internal vacuum, pneumatic and CTD test.

At least one hour before the deployment time, each float was activated by rubbing a magnet on the reset space located by one sticker on the hull of the float. Placing a transmission detector within 5 cm of the aerial, six Argos transmissions, eight seconds apart, are heard upon activation. After a few minutes (up to 12 minutes) the float will start beeping with a repetition period of about 40 seconds. Each float was deployed within one hour from the activation time. The deployment was performed by two scientists lowering the float from the starboard quarter. To lower the float gently into the water a rope passed through the white ring on the top of the float was used. Ship speed was about 1 knot.

After each deployment, confirmation emails were sent to the relevant project handlers at the BODC, Met Office and the National Oceanography Centre.

| APEX Argo floats | | | | | |
|------------------|------------|------|-------|---------|----------|
| Argo ID | Date | jday | time | lat | lon |
| 4882 | 14/10/2012 | 288 | 09:05 | 32.1653 | -14.6515 |
| 4881 | 22/10/2012 | 296 | 12:45 | 26.1942 | -19.3247 |
| 5014 | 31/10/2012 | 305 | 12:03 | 25.3820 | -23.5422 |
| 5013 | 10/11/2012 | 315 | 20:00 | 25.2141 | -53.4887 |
| 5012 | 13/11/2012 | 318 | 21:00 | 25.9417 | -62.9697 |

Table 8: Argo floats deployments

| Met Office drifters | | | | | |
|---------------------|------------|------------|------------|------------|------------|
| Argos S/N | 910180 | 022040 | 912280 | 919170 | 912120 |
| day | 14/10/2012 | 22/10/2012 | 31/10/2012 | 10/11/2012 | 12/11/2012 |
| Lat | 32.299 | 26.196 | 25.382 | 25.214 | 25.9417 |
| Lon | -14.640 | -19.323 | -23.542 | -53.489 | -62.9697 |

Table 9: SVP Met Office drifters deployment

| Salinity drifters deployments | | | |
|-------------------------------|-----------------|--------|---------|
| Argos ID | Deployment time | Lat | Lon |
| 36323 | 12:15:35 | 24.450 | -37.700 |
| 36326 | 12:47:40 | 24.450 | -37.804 |
| 36433 | 13:17:00 | 24.450 | -37.899 |
| 36243 | 13:48:30 | 24.450 | -38.002 |
| 36430 | 14:19:45 | 24.450 | -38.103 |
| 36244 | 14:47:30 | 24.450 | -38.194 |
| 36373 | 15:18:30 | 24.450 | -38.296 |
| 36363 | 15:49:34 | 24.440 | -38.399 |
| 36245 | 16:19:30 | 24.450 | -38.500 |

Table 10: SVP with salinity sensor for the SPURS project

10.2 Surface Velocity Profiler

The Surface Velocity Profiler (SVP) is a drifting buoy specifically designed to track ocean currents at a fixed depth of 15 meters. The key elements of the SVP include the surface float which contains the telemetry system and sensors necessary to retrieve and transmit the required data and the drogue that it is designed to hold the SVP in place on the ocean surface.

During the Di382, five SVPs for the Met office (UK) were deployed in five different locations (Table 9). The locations of the deployment were the same as the Argo floats. The deployment procedure was very simple and the only important consideration was to activate the drifter removing the ON/OFF magnet between 10 and 30 minutes past the hour. The deployment was performed by two scientists.

After each deployment the relevant project handlers at the Met Office were contacted. The drifters were all confirmed to be operational.

10.3 Salinity drifter

Salinity Processes in the Upper Ocean Regional Study (SPURS) is a US-European project that seeks to understand the main processes controlling the upper ocean salinity budget with new salinity sampling tools. Nine SVP drifters specially equipped with a sensor to measure the sea surface salinity (SSS) were deployed on this cruise. The deployment of these drifters was done in a region requested by the SPURS project (Figure 10). Drifters were contained in a cardboard box and they were deployed in their box from the aft deck of *RRS Discovery*. It was necessary to remove two rubber plugs and an activation magnet from the floats prior to deployment.

11 RAPID and TEOS-10

Charlotte Mielke

The International Thermodynamic Equation of Seawater, 2010 (TEOS-10) (IOC & IAPSO, 2010) replaces the old equation of seawater, EOS-80. The basis of the description is a Gibbs function formulation, where the Gibbs function is a function of Absolute Salinity, temperature and pressure. The use of Absolute Salinity instead of Practical Salinity is one of the major differences between TEOS-10 and EOS-80. Another difference that is relevant here is the use of Conservative Temperature instead of potential temperature. More information about TEOS-10 can be found at www.teos-10.org.

Absolute Salinity is defined as the mass fraction of dissolved materials in seawater and has units of g/kg, so unlike Practical Salinity, it is given in SI units. But the main reason for using Absolute Salinity is that thermodynamic properties, for example density, directly depend on Absolute Salinity, but not Practical Salinity. In this way, Absolute Salinity is the more natural quantity. Also, the use of Absolute Salinity makes it possible to take spatial variations in seawater composition into account. This has a non-negligible influence on the calculation of density gradients and thereby on the calculation of ocean velocities.

Furthermore, the use of theoretical relations such as the ideal-solution law and the Debye–Hückel limiting law as well as new, more accurate measurements such as the temperatures of maximum density has improved the calculation of sea water density, especially for seawater at high pressures and low temperature.

In the following, we want to investigate how the use of the new toolbox affects the calculation of geostrophic velocities and thereby mass transports in the RAPID framework.

11.1 MOC timeseries

First, we calculate an MOC timeseries from the an eastern and a western boundary profile using a simple box model for the calculation of the internal transport. In the old version, geostrophic velocity is calculated using the function `geo_vel`. In the new version, dynamic height is calculated using `gsw_geo_dyn_height`. Afterwards, `gsw_geostrophic_velocity` is used to calculate the geostrophic velocity. Western Boundary Wedge, Gulf Stream and Ekman transport are added subsequently. Below the depth of the RAPID array (4820m), a time-invariant AABW profile is used. A barotropic correction is then applied to ensure mass balance.

In this simple calculation, the difference in overturning between the old and the new approach has a mean of 0.48 Sv and a standard deviation of 0.05 Sv (Figures 13 and 14). Note that there is a gap in the data due to a combination of dead batteries and a collapsed mooring in the west. To further examine the differences in mid-ocean transport, we estimate the transports in depth classes: thermocline recirculation (0 – 800 m), intermediate water (800 – 1100 m), upper North Atlantic deep water (UNADW, 1100 – 3000m) and lower North Atlantic deep water (3000 – 5000 m).

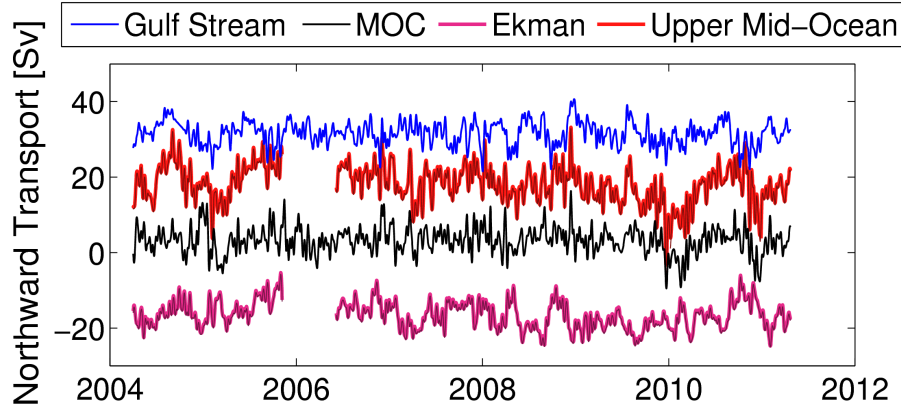


Figure 13: Gulf Stream, Ekman transport, upper mid-ocean transport and MOC timeseries from the box model calculation. Gulf Stream and Ekman transport timeseries are the same for both cases. For the upper mid-ocean transport and the MOC, results from the old toolbox are plotted in light and bold, while results from the new toolbox are dark and thin.

| | old | TEOS-10 | difference |
|--------------------------------------|--------|---------|------------|
| Thermocline recirculation (0 – 800m) | –17.53 | –17.13 | –0.41 |
| Intermediate water (800 – 1100m) | 0.41 | 0.50 | –0.09 |
| UNADW (1100 – 3000m) | –11.07 | –10.72 | –0.36 |
| LNADW (3000 – 5000m) | –7.04 | –7.71 | 0.67 |

Table 11: Mean mid-ocean layer transports in the old and the new toolbox. Data are in Sverdrup.

In the upper 3000 m, transports are larger for the old toolbox, while the transport of LNADW is larger in the new toolbox.

11.2 Antarctic Bottom Water

In the above calculation of the Overturning, a time-invariant profile is used for the Antarctic Bottom Water, as it lies below the depth of the RAPID array. In the following, we therefore estimate the deep transports from five hydrographic sections (1982, 1992, 1998, 2004 and 2010) to investigate the effects of the new toolbox.

Transports are calculated from the geostrophic velocity between station pairs, where the geostrophic velocity is calculated as in Section 11.1. Following Frajka-Williams et al. (2011), 4100dbar is chosen as the level of no motion, and the deep transport is calculated between 70.5°W and 49°W and below 4100dbar (Table 12 and Figure 15).

It should be noted that the transport estimate is very sensitive to the choice of the western limit of the integration. For example, if 71.0°W is chosen as the western limit instead of 70.5°W, the old toolbox yields only 3.28 Sv, whereas the deep transport amounts to 4.38 Sv for 71.5°W as the western limit. This may explain the discrepancies between the results presented here and the results found by Frajka-

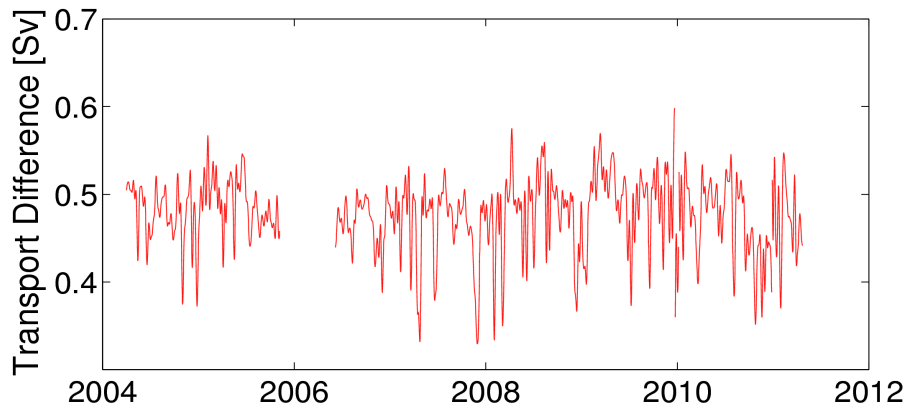


Figure 14: Difference in the calculated MOC timeseries (old–new, equal to the difference in upper mid-ocean transports).

| | 1981 | 1992 | 1998 | 2004 | 2010 |
|------------|------|------|------|------|------|
| old method | 3.90 | 2.8 | 2.25 | 2.03 | 2.69 |
| TEOS-10 | 4.29 | 3.16 | 2.57 | 2.36 | 2.99 |

Table 12: Deep transport estimates from hydrographic sections. Transports are calculated as the zonal integral between 70.5°W and 49°W and below 4100dbar. Data are in Sv.

Williams et al. (2011), where each section is interpolated on a fine longitudinal and pressure grid before the calculation. As the purpose here is to compare the old to the new seawater toolbox rather than getting a very accurate estimate of the deep transports, no such steps were taken here.

The new toolbox yields larger deep ocean transports for all hydrographic sections, with an average difference of 0.34 Sv, in agreement with the finding in Section 11.1, where we also found larger transports for the deeper layers.

From the deep transport profiles obtained using TEOS-10, we have calculated a mean vertical profile, which was then smoothed using the moving average filter provided by the Matlab function `smooth` with a span of 30 (Figure 16). The mass transport of the smoothed profile is 3.45 Sv, and the profile has been saved as

`cruise/TEOS-10/DATA/aabw_profile.mat`

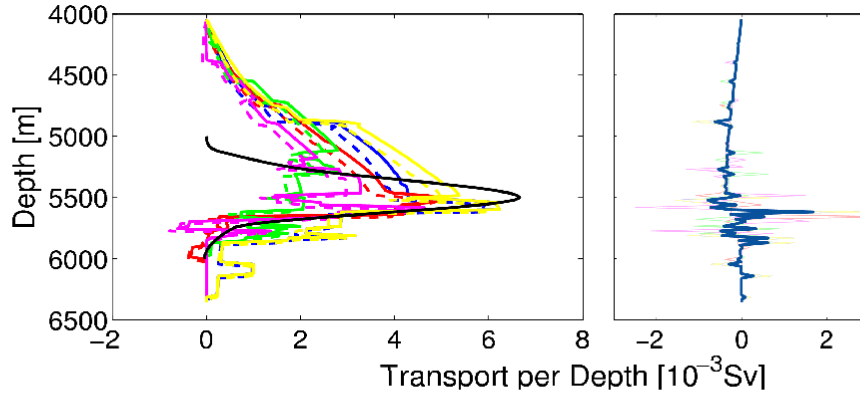


Figure 15: Left: Deep transport profiles from hydrographic sections, calculated using the old method (dashed) and TEOS-10 (solid). Profiles for the same year are in the same color (1982: blue), 1992: red, 1998: green, 2004: magenta, 2010: yellow). For comparison, the time-invariant AABW profile used in the box model calculations is also plotted. Right: Mean difference between the deep transport profiles. Individual differences are plotted faintly.

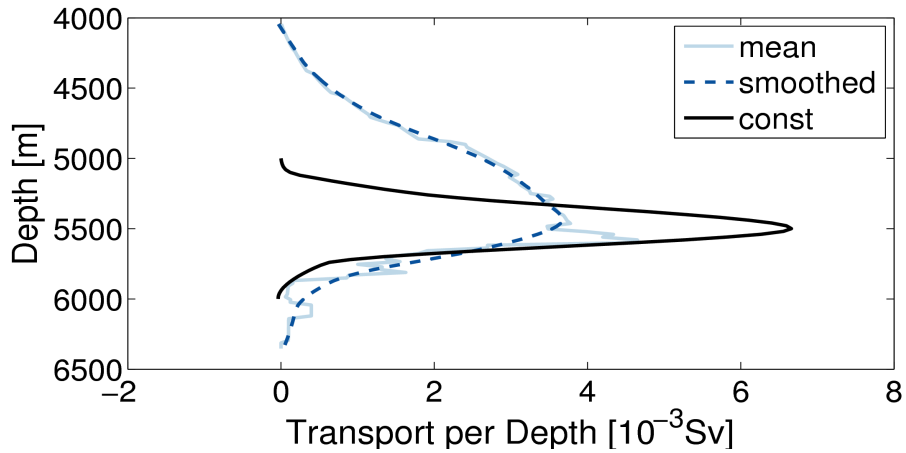


Figure 16: Mean deep transport profiles from hydrographic sections calculated with TEOS-10, as-is (light blue, solid) and smoothed (dark blue, dashed). For comparison, the time-invariant AABW profile used in the box model calculations is also plotted (black).

12 Triangulation of Deployed Moorings

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In some cases the positions of deployed moorings were checked by obtaining acoustic ranges from a transducer deployed over the side of the ship. Attempts to use the ships transducer to communicate with the mooring acoustic releases were not successful. Matlab scripts used to determine positions were updated during the cruise to make use of the `m_map` Matlab toolbox routines `m_idist` and `m_fdist` to calculate distances between points on an ellipsoidal earth. When three or more ranges were available the `Anchor5.m` program solves a least squares problem to determine a position for the mooring anchor, along with an error estimate. The routine `Triangle5.m` provides a graphical representation of the information from the ranges only. A further routine `plan_triangle.m` was used to select positions to be used for triangulation.

To obtain accurate ranges it is important to deploy the transducer at the same depth each time particularly when taking a range close to the mooring.

The results are listed in Section 12.1.

12.1 Triangulation of non-retrieved moorings

MAR1L6

The Di359 cruise report listed a triangulated position of: 24.2038°N 49.7279°W, with a corrected water depth of 5222 m. During Di382 two ranges were made to the mooring these were not sufficient for a full triangulation but are consistent with the above location a best estimate being: 24.204°N 49.727°W.

MAR0

The JC064 cruise report gives an anchor drop position of 25.1047°N 52.0102°W with corrected water depth of 5529 m. During Di382 five ranges were made to the mooring. These suggested a corrected water depth of not more than 5500 m. Using the swath data from JC064 and the acoustic ranges from Di382 best estimate of the position is 25.1042°N 52.0092°W. This is located near the top of a hillock of the order of 50 m high and 200 m across.

13 Details of Instruments on Lowered CTDs

David Smeed

| Cast | Date | Microcat serial numbers | | | | | | | | | | | | | | | |
|------|----------|-------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 | 12/10/12 | 3207 | 3214 | 3247 | 3251 | 3252 | 3253 | 3255 | 3270 | 3484 | 5766 | 5772 | 6829 | | | | |
| | | T | | | | | | T | P | | | c | | | | | |
| 2 | 12/10/12 | 3212 | 3216 | 3256 | 3264 | 3277 | 5765 | 5777 | 6817 | 6818 | 6819 | 6823 | 6831 | | | | |
| | | | | | C | | C | | | | | | | | | | |
| 3 | 15/10/12 | 3213 | 3220 | 3249 | 3893 | 3912 | 4066 | 4710 | 4712 | 4713 | 4718 | 4720 | 6331 | 6816 | | | |
| | | | | | | | | | | | | | | | | | |
| 4 | 22/10/12 | 3257 | 3259 | 3271 | 3916 | 4184 | 4462 | 4464 | 4466 | 4473 | 4474 | 5238 | 5246 | | | | |
| | | | | | | | | C | | | | | P | | | | |
| 5 | 24/10/12 | 3215 | 3224 | 3230 | 3232 | 3234 | 3244 | 3265 | 3905 | 3907 | 6799 | 6800 | 6801 | 6802 | | | |
| | | | | | | | | | | | | | | | | | |
| 6 | 24/10/12 | 3229 | 3268 | 3900 | 3913 | 4178 | 5241 | 5242 | 6127 | 6322 | 6832 | 6841 | 7300 | | | | |
| | | | | | | C,P | T | p | T | C | | | | | | | |
| 7 | 24/10/12 | 3891 | 4060 | 4062 | 5244 | 5245 | 5247 | 5484 | 5486 | 5789 | 6113 | 6804 | 6805 | | | | |
| | | No data | | | | | | | | | | | | | | | |
| 8 | 7/11/12 | 3222 | 3225 | 3254 | 3266 | 3281 | 3901 | 3904 | 4461 | 4468 | 6112 | 6798 | 6811 | 6815 | 6833 | 6834 | 6838 |
| | | | | | | C,P | T | | C | | | | | | | | 7681 |
| 10 | 10/11/12 | 3284 | 3903 | 3910 | 4708 | 4717 | 4721 | 4797 | 4799 | 4800 | 5485 | 5784 | 5788 | 5978 | 6324 | 6807 | 6812 |
| | | | | | | | | | | | | | | | | | |
| 11 | 14/11/12 | 3919 | 3932 | 4306 | 5240 | 5485 | 5767 | 5778 | 5783 | 6119 | 6120 | 6128 | 6321 | 6335 | 6806 | 6813 | 6830 |
| | | C | | | | C | | | | | | | P | C | | P | 7723 |
| 12 | 18/11/12 | 3248 | 3902 | 4068 | 4072 | 4180 | 4471 | 4472 | 5768 | 5773 | 5782 | 6121 | 6123 | 6820 | 7363 | 7468 | |
| | | | P | | | | | | T | | | | | | T | | |
| 13 | 18/11/12 | 3911 | 3931 | 5779 | 5786 | 5787 | 6124 | 6137 | 6320 | 6323 | 6325 | 6326 | 6827 | 6840 | 7362 | 7470 | |
| | | | | C | | | | | | | | | P | | P | | |
| 14 | 19/11/12 | 4068 | 4070 | 4071 | 4072 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 16 | 21/11/12 | 3209 | 3483 | 3933 | 3934 | 4307 | 5762 | 5763 | 5780 | 5781 | 5785 | 6333 | 6821 | 6822 | 6828 | | |
| | | | | | | | | | | C | | | | | | | |
| 17 | 21/11/12 | 3928 | 4305 | 4470 | 4475 | 4719 | 5239 | 5243 | 6115 | 6116 | 6117 | 6824 | 6825 | 7361 | | | |
| | | | | | | | | | | P | | | | | | | |

14 Instrument Record Lengths

David Smeed

| Mooring | NominalInst Depth (m) | S/N | Mean Pres. (dbar) | Start Date | End Date | No Records | Comments |
|-----------------|-----------------------------|-----|-------------------------|------------|------------|---------------|--|
| ebh5_7_201131 | 100 | 337 | 3223 | 11/09/2011 | 28/10/2012 | 19814 | |
| | 175 | 337 | 3228 | 11/09/2011 | 28/10/2012 | 19814 | |
| | 250 | 337 | 3269 | 11/09/2011 | 28/10/2012 | 19814 | |
| | 450 | 310 | 305 | 11/09/2011 | 23/08/2012 | 16656 | Battery failure |
| | 750 | 366 | 278 | 11/09/2011 | 28/09/2012 | 18371 | Beam failure + Battery failure 28/9/12 |
| ebh4_9_201129 | 950 | 366 | 322 | 11/09/2011 | 28/10/2012 | 19814 | |
| | 325 | 337 | 3233 | 11/09/2011 | 28/10/2012 | 19812 | |
| | 400 | 337 | 3258 | | | | |
| | 500 | 337 | 3254 | | | | |
| | 600 | 337 | 3219 | | | | instrument flooded |
| ebh4l2_2_201110 | 700 | 337 | 3221 | 11/09/2011 | 28/10/2012 | 19813 | |
| | 800 | 337 | 3222 | 11/09/2011 | 28/10/2012 | 19813 | |
| | 1009 | 465 | 002 | 12/01/2011 | 28/10/2012 | 31418 | |
| | 1009 | 465 | 004 | 12/01/2011 | 28/10/2012 | 31418 | |
| | 900 | 337 | 3907 | 12/09/2011 | 17/10/2012 | 19236 | |
| ebh3_8_201128 | 1000 | 337 | 6802 | 12/09/2011 | 17/10/2012 | 19236 | |
| | 1100 | 337 | 6801 | 12/09/2011 | 17/10/2012 | 19236 | |
| | 1200 | 337 | 6800 | 12/09/2011 | 17/10/2012 | 19236 | |
| | 1300 | 366 | 298 | 12/09/2011 | 17/10/2012 | 19236 | |
| | 1400 | 337 | 6799 | 12/09/2011 | 17/10/2012 | 19236 | |
| ebh2_8_201127 | 1600 | 337 | 3230 | 12/09/2011 | 16/10/2012 | 19192 | |
| | 1800 | 337 | 3224 | 12/09/2011 | 16/10/2012 | 19192 | |

| | | | | | | | | |
|------------------|------|-----|------|--------|------------|------------|-------|---|
| | 1900 | 366 | 332 | 1971.4 | 12/09/2011 | 20/09/2011 | 27912 | 20 min. samp. , Beam Filare then battery failure 4/10/12 |
| ebh1.8_201124a | 2000 | 337 | 3265 | 2037.6 | 12/09/2011 | 16/10/2012 | 19192 | Battery failure |
| | 2500 | 337 | 3215 | 2488.4 | 13/09/2011 | 06/10/2011 | 1101 | |
| | 2900 | 310 | 301 | 2937.4 | 13/09/2011 | 06/10/2011 | 1100 | |
| | 3000 | 337 | 3244 | 3040.6 | 13/09/2011 | 06/10/2011 | 1101 | |
| ebh1.8_201124b | 2500 | 337 | 3215 | 2480.8 | 06/10/2012 | 15/10/2012 | 17992 | Battery failure |
| | 2900 | 310 | 301 | 2937.4 | 06/10/2012 | 08/10/2012 | 17656 | |
| | 3000 | 337 | 3244 | 3038.4 | 06/10/2012 | 15/10/2012 | 17992 | |
| | 5096 | 465 | 060 | 3059.7 | 10/01/2011 | 06/10/2011 | 12904 | |
| ebh1l7_7_201125a | 5096 | 465 | 064 | 3059.4 | 10/01/2011 | 06/10/2011 | 12902 | Battery failure |
| | 5096 | 465 | 060 | 3059.7 | 07/10/2011 | 15/10/2012 | 17946 | |
| | 5096 | 465 | 064 | 3059.4 | 07/10/2011 | 15/10/2012 | 17944 | |
| | 3500 | 337 | 3232 | 3490.6 | 15/09/2011 | 23/10/2012 | 19383 | |
| ebhi.8_201132 | 4000 | 337 | 3234 | 4035.8 | 15/09/2011 | 23/10/2012 | 19383 | Battery failure |
| | 4400 | 310 | 302 | 4465.6 | 15/09/2011 | 23/10/2012 | 19383 | |
| | 4500 | 337 | 3905 | 4575.7 | 15/09/2011 | 23/10/2012 | 19383 | |
| | 50 | 337 | 5486 | 14.6 | 17/09/2011 | 24/10/2012 | 19335 | |
| eb1.10_201122 | 105 | 337 | 3891 | 68.4 | 17/09/2011 | 24/10/2012 | 19335 | Battery failure |
| | 175 | 337 | 5484 | 140.8 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 250 | 337 | 6804 | 216.7 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 325 | 337 | 6805 | 293.1 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 400 | 337 | 5789 | 391.5 | 17/09/2011 | 24/10/2012 | 19335 | Battery failure |
| | 600 | 337 | 5247 | 575.4 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 800 | 337 | 5245 | 772.1 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 1000 | 337 | 6113 | 966.8 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 1200 | 337 | 5244 | 1178.8 | 17/09/2011 | 24/10/2012 | 19335 | Battery failure |
| | 1500 | 366 | 273 | 1483.5 | 17/09/2011 | 29/07/2012 | 16125 | |
| | 1600 | 337 | 6814 | 1578.2 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 2000 | 337 | 3206 | 1993.9 | 17/09/2011 | 24/10/2012 | 19335 | |

| | | | | | | | | |
|-----------------|------|-----|----------|--------|------------|------------|-------|--|
| | 2500 | 337 | 6114 | 2492.9 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 3000 | 337 | 3266 | 3018.0 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 3500 | 337 | 6811 | 3535.7 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 4000 | 337 | 6815 | 4053.2 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 4500 | 337 | 4549 | 4506.5 | 17/09/2011 | 24/10/2012 | 19335 | |
| | 4990 | 310 | 303 | 5084.5 | 17/09/2011 | 11/10/2012 | 18737 | Battery failed |
| | 5000 | 337 | 3225 | 5095.3 | 17/09/2011 | 24/10/2012 | 19335 | |
| eb117_7_201102 | 5100 | 465 | 054 | 5201.7 | 06/01/2011 | 24/10/2012 | 31516 | |
| | 5100 | 465 | 061 | | | | | Flooded |
| mar3_8_201137 | 2500 | 337 | 5776 | 2511.9 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 3000 | 337 | 5774 | 3022.5 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 3500 | 337 | 6835 | 3527.1 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 4000 | 337 | 6810 | 4048.1 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 4500 | 337 | 6836 | 4565.5 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 5000 | 337 | 5770 | 5083.5 | 21/09/2011 | 05/11/2012 | 19716 | |
| | 5000 | 302 | 35612568 | 5090.0 | 21/09/2011 | 05/11/2012 | 19716 | |
| mar316_6_201031 | 5050 | 465 | 062 | 5140.5 | 01/10/2011 | 05/11/2012 | 32342 | |
| | 5050 | 465 | 394 | 5141.9 | 01/01/2011 | 05/11/2012 | 32343 | |
| mar2_8_201136 | 1100 | 337 | 3931 | 1128.7 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 1400 | 337 | 3911 | 1428.6 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 1600 | 337 | 6115 | 1615.0 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 1800 | 337 | 6116 | 1816.2 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 2250 | 337 | 6117 | 2280.0 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 2750 | 337 | 3928 | 2817.9 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 3257 | 337 | 5243 | 3321.1 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 3750 | 337 | 5239 | 3833.5 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 4250 | 337 | 5778 | 4357.1 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 4750 | 337 | 6119 | 4849.4 | 25/09/2011 | 07/11/2012 | 19626 | |
| | 5150 | 302 | 35612571 | | 25/09/2011 | 07/11/2012 | 19626 | Pres. Sens fail. + No setup for C and T |
| | 5160 | 337 | 6120 | 5260.7 | 25/09/2011 | 07/11/2012 | 19626 | |

| | | | | | | | |
|-----------------|------|-----|----------|--------|------------|------------|-----------------------|
| mar1_8_201134 | 50 | 337 | 6335 | 41.0 | 25/09/2011 | 08/11/2012 | 19666 |
| | 100 | 337 | 6321 | 83.7 | 25/09/2011 | 08/11/2012 | 19668 |
| | 175 | 337 | 6324 | 171.6 | 25/09/2011 | 08/11/2012 | 19668 |
| | 250 | 337 | 4721 | 252.1 | 25/09/2011 | 08/11/2012 | 19668 |
| | 325 | 337 | 5485 | 331.1 | 25/09/2011 | 08/11/2012 | 19668 |
| | 400 | 337 | 6806 | 409.7 | 25/09/2011 | 08/11/2012 | 19668 |
| | 600 | 337 | 6807 | 608.7 | 25/09/2011 | 08/11/2012 | 19668 |
| | 800 | 337 | 4717 | 811.6 | 25/09/2011 | 08/11/2012 | 19668 |
| | 1000 | 337 | 6809 | 1012.2 | 25/09/2011 | 08/11/2012 | 19668 |
| | 1200 | 337 | 4708 | 1217.3 | 25/09/2011 | 08/11/2012 | 19668 |
| | 1500 | 366 | 295 | 1514.5 | 25/09/2011 | 11/12/2011 | 19668 |
| | 1600 | 337 | 5784 | 1641.2 | 25/09/2011 | 08/11/2012 | 19668 |
| | 2000 | 337 | 6812 | 2034.4 | 25/09/2011 | 08/11/2012 | 19668 |
| | 2500 | 337 | 3932 | 2566.4 | 25/09/2011 | 08/11/2012 | 19668 |
| | 3000 | 337 | 6813 | 3082.4 | 25/09/2011 | 08/11/2012 | 19668 |
| | 3500 | 337 | 3919 | 3561.4 | 25/09/2011 | 08/11/2012 | 19668 |
| | 4000 | 337 | 7723 | 4131.7 | 25/09/2011 | 08/11/2012 | 19668 |
| | 4500 | 337 | 5783 | 4645.9 | 25/09/2011 | 08/11/2012 | 19668 |
| | 5000 | 302 | 35612572 | 5172.2 | 25/09/2011 | 08/11/2012 | 19669 |
| | 5000 | 337 | 6830 | 5150.7 | 25/09/2011 | 08/11/2012 | 19668 |
| mar1l6_6_201027 | | | | | | | Not setup for C and T |
| mar0_5_201133 | | | | | | | Mooring not recovered |
| wb6_6_201201 | 5100 | 337 | 5240 | 5170.4 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5200 | 337 | 6128 | 5272.7 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5300 | 337 | 5767 | 5392.9 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5400 | 368 | 6747 | 5543.1 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5400 | 337 | 7361 | 5502.2 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5495 | 337 | 4306 | 5597.0 | 19/02/2012 | 14/11/2012 | 12938 |
| | 5500 | 465 | 390 | 5611.2 | 19/02/2012 | 14/11/2012 | 12924 |
| | 5500 | 465 | 040 | 5608.9 | 19/02/2012 | 14/11/2012 | 12937 |
| wb4_9_201202 | 50 | 337 | 4071 | 60.9 | 24/02/2012 | 18/11/2012 | 12852 |

| | | | | | | |
|------|-----|------|--------|------------|------------|-------|
| 100 | 310 | 445 | 109.2 | 24/02/2012 | 18/11/2012 | 12853 |
| 100 | 337 | 4070 | 113.1 | 24/02/2012 | 18/11/2012 | 12852 |
| 250 | 337 | 5787 | 251.7 | 24/02/2012 | 18/11/2012 | 12852 |
| 400 | 370 | 5963 | 412.4 | 24/02/2012 | 18/11/2012 | 12851 |
| 400 | 337 | 5779 | 407.2 | 24/02/2012 | 18/11/2012 | 12852 |
| 600 | 337 | 5786 | 607.9 | 24/02/2012 | 18/11/2012 | 12852 |
| 800 | 370 | 6751 | - | 24/02/2012 | 18/11/2012 | 12852 |
| 800 | 337 | 6827 | 808.6 | 24/02/2012 | 18/11/2012 | 12852 |
| 1000 | 337 | 7362 | 1006.2 | 24/02/2012 | 18/11/2012 | 12852 |
| 1200 | 370 | 6743 | 18.1 | 24/02/2012 | 18/11/2012 | 12852 |
| 1200 | 337 | 7470 | 1216.4 | 24/02/2012 | 18/11/2012 | 12852 |
| 1500 | 370 | 9406 | 1508.2 | 24/02/2012 | 18/11/2012 | 12852 |
| 1600 | 337 | 6840 | 1611.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 2000 | 370 | 9439 | 2029.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 2000 | 337 | 6124 | 2012.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 2500 | 337 | 6326 | 2532.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 3000 | 370 | 9433 | 3068.9 | 24/02/2012 | 18/11/2012 | 12852 |
| 3000 | 337 | 6325 | 3046.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 3500 | 337 | 6323 | 3556.5 | 24/02/2012 | 18/11/2012 | 12852 |
| 4000 | 370 | 9420 | 4076.4 | 24/02/2012 | 18/11/2012 | 12852 |
| 4000 | 337 | 6320 | 4072.1 | 24/02/2012 | 18/11/2012 | 12852 |
| 4500 | 337 | 6137 | 4569.1 | 24/02/2012 | 18/11/2012 | 12852 |
| 4630 | 370 | 5885 | 4700.1 | 24/02/2012 | 18/11/2012 | 12852 |
| 4700 | 465 | 014 | 4831.0 | 23/04/2011 | 18/11/2012 | 27573 |
| 4700 | 465 | 057 | 4830.0 | 23/04/2011 | 18/11/2012 | 27573 |
| 50 | 337 | 5781 | 58.4 | 28/02/2012 | 20/11/2012 | 12750 |
| 100 | 310 | 448 | 119.7 | 28/02/2012 | 20/11/2012 | 12750 |
| 100 | 337 | 5780 | 115.9 | 28/02/2012 | 20/11/2012 | 12750 |
| 175 | 310 | 449 | 189.9 | 28/02/2012 | 20/11/2012 | 12750 |
| 175 | 337 | 6821 | 179.2 | 28/02/2012 | 20/11/2012 | 12750 |
| 325 | 337 | 6822 | 331.3 | 28/02/2012 | 20/11/2012 | 12750 |

wb4l7_7_201120

wb2_10_201205

No pressure

large pressure offset

| | | | | | | | |
|---------------|-----|------|--------|------------|------------|-------|---|
| 400 | 370 | 6753 | - | 28/02/2012 | 20/11/2012 | 12750 | no pressure |
| 400 | 337 | 3933 | 419.1 | 28/02/2012 | 20/11/2012 | 12750 | |
| 500 | 337 | 5763 | 505.1 | 28/02/2012 | 20/11/2012 | 12750 | |
| 700 | 337 | 4307 | 707.7 | 28/02/2012 | 20/11/2012 | 12750 | |
| 800 | 370 | 6119 | 818.7 | 28/02/2012 | 20/11/2012 | 12750 | |
| 900 | 337 | 4470 | 908.8 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1100 | 337 | 5762 | 1114.4 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1200 | 370 | 5884 | 1221.4 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1300 | 337 | 3209 | 1314.6 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1500 | 370 | 6176 | 1537.5 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1500 | 337 | 6333 | 1520.2 | 28/02/2012 | 20/11/2012 | 12741 | Bad data for few hours in middle and at end of record |
| 1700 | 337 | 5785 | 1724.1 | 28/02/2012 | 20/11/2012 | 12750 | |
| 1900 | 337 | 3934 | 1926.3 | 28/02/2012 | 20/11/2012 | 12750 | |
| 2050 | 370 | 5967 | 2103.5 | 28/02/2012 | 20/11/2012 | 12750 | |
| 2300 | 337 | 4475 | 2335.3 | 28/02/2012 | 20/11/2012 | 12750 | |
| 2800 | 337 | 4719 | 2844.7 | 28/02/2012 | 20/11/2012 | 12750 | |
| 3000 | 370 | 9266 | 3071.0 | 28/02/2012 | 20/11/2012 | 12750 | |
| 3300 | 337 | 3483 | 3338.4 | 28/02/2012 | 20/11/2012 | 12750 | |
| 3850 | 337 | 6828 | 3911.2 | 28/02/2012 | 20/11/2012 | 12750 | |
| 3885 | 465 | 055 | 3956.2 | 28/04/2011 | 20/11/2012 | 27453 | |
| 3885 | 465 | 056 | 3955.8 | 28/04/2011 | 20/11/2012 | 27453 | |
| 1500 | 370 | 9402 | 1334.6 | 26/02/2012 | 21/11/2012 | 12891 | |
| 2200 | 370 | 9427 | 2066.7 | 26/02/2012 | 21/11/2012 | 12891 | |
| 3000 | 370 | 9444 | 2902.4 | 26/02/2012 | 21/11/2012 | 12891 | |
| 3800 | 370 | 6132 | 3822.6 | 26/02/2012 | 21/11/2012 | 12891 | |
| 3800 | 337 | 6825 | 3767.4 | 26/02/2012 | 21/11/2012 | 12891 | |
| 4300 | 337 | 6824 | 4334.5 | 26/02/2012 | 21/11/2012 | 12891 | |
| 4700 | 370 | 5879 | 4704.3 | 26/02/2012 | 21/11/2012 | 12891 | |
| 4780 | 337 | 4305 | 4760.6 | 26/02/2012 | 21/11/2012 | 12891 | |
| 50 | 337 | 6123 | 54.9 | 29/02/2012 | 17/11/2012 | 12564 | |
| wb2l_7_201119 | | | | | | | |
| wbh2_6_201204 | | | | | | | |
| wb1_9_201208 | | | | | | | |

| | | | | | | | |
|-----------------|-----|------|----------|------------|------------|-------|---|
| 100 | 370 | 9409 | 105.2 | 29/02/2012 | 17/11/2012 | 12564 | |
| 100 | 337 | 6121 | 104.9 | 29/02/2012 | 17/11/2012 | 12564 | |
| 175 | 337 | 4072 | 178.3 | 29/02/2012 | 17/11/2012 | 12564 | |
| 250 | 337 | 6820 | 262.2 | 29/02/2012 | 17/11/2012 | 12564 | |
| 325 | 337 | 4180 | 336.3 | 29/02/2012 | 17/11/2012 | 12564 | |
| 400 | 377 | 5773 | 414.0 | 29/02/2012 | 17/11/2012 | 12564 | |
| 400 | 370 | 5890 | 419.2 | 29/02/2012 | 17/11/2012 | 12564 | |
| 500 | 337 | 3248 | 514.9 | 29/02/2012 | 17/11/2012 | 12564 | |
| 600 | 337 | 3902 | 617.4 | 29/02/2012 | 17/11/2012 | 12564 | |
| 700 | 337 | 4472 | 718.4 | 29/02/2012 | 17/11/2012 | 12564 | |
| 800 | 370 | 5897 | - | 29/02/2012 | 17/11/2012 | 12564 | No pressure |
| 800 | 337 | 5768 | 831.0 | 29/02/2012 | 17/11/2012 | 12564 | |
| 900 | 337 | 5782 | 930.0 | 29/02/2012 | 17/11/2012 | 12564 | |
| 1000 | 337 | 4068 | 1032.3 | 29/02/2012 | 17/11/2012 | 12564 | |
| 1000 | 337 | 4471 | 1132.9 | 29/02/2012 | 17/11/2012 | 12564 | |
| 1200 | 370 | 5889 | 1247.3 | 29/02/2012 | 17/11/2012 | 12564 | Seems to have c. 20db error in pressure |
| 1200 | 337 | 7468 | 1239.3 | 29/02/2012 | 17/11/2012 | 12564 | |
| 1350 | 337 | 7363 | 1356.5 | 29/02/2012 | 17/11/2012 | 12564 | |
| wbal2_2_201121 | 495 | 417 | 522.7 | 30/04/2011 | 21/11/2012 | 27410 | Lander moved due to currents |
| 495 | 465 | 039 | 523.3 | 30/04/2011 | 21/11/2012 | 27410 | data needs correction for pressure jump |
| wbadcp_9_201206 | 614 | 324 | 597.6(m) | 28/02/2012 | 21/11/2012 | 6402 | No correction for soundspeed |

15 Lost or Damaged Instruments and Hardware

Darren Rayner

| Mooring | Equipment damages | Equipment lost | Details |
|---------|---|---|--|
| WB1 | 2 x SBE37 MicroCATs - Conductivity guard missing from each | | Likely strumming of mooring shaking out bolts |
| MAR3 | 4 x 17" glass spheres | | Implosion of 4 out of 8 from deepest buoyancy package |
| MAR1L6 | | 1 x 12" glass, 8 x 17" glass, 1 x Billings float, 1 x Argos beacon, 1 x light, 2 x SeaBird SBE53 BPRs, 1 x Ixsea AR861 acoustic release, 1 x Ixsea RT661 acoustic release | Mooring not recoverable. Likely double implosion of glass buoyancy packages |
| MAR0 | | 1 x 12" glass, 12 x 17" glass, 1 x Billings float, 1 x Argos beacon, 1 x light, 2 x SeaBird SBE53 BPRs, 2 x Ixsea AR861 acoustic release, 5 x SBE37 MicroCATs | Mooring not recoverable. Likely implosion of deepest buoyancy package with sympathetic implosions meaning all 8 failed |
| WB6 | 2 x 17" glass | 1 x Billings float, 1 x Argos beacon, 1 x Light | Implosion of glass and Billings float. Billings float implosion shattered mast and caused loss of beacons |
| EBH4 | 1 x SBE37 MicroCAT | | Flooded. Bulkhead connector missing. |
| EB1L7 | 1 x Billings float, 1 x SBE53 BPR | | Implosion of Billings float. Flooding of BPR |
| EB1 | | 1 x mini-Trimsyn | Missing from pick up line. Assumed pull off by wave motion as top of mooring was too shallow. |

| | | |
|------|---------------------------------------|---|
| WB2 | 1 x Ixsea Oceanographic AR861 release | Corrosion of top ring above transducer cage. Ring completely missing and clearly caused by mismatch of touching metals as part of release construction. |
| WB4 | 1 x Nortek Aquadopp current meter | Corrosion of 1 pin in bulkhead connector plug. |
| WBH2 | 2 x 17" glass | Implosion of 2 out of 5 of the deepest buoyancy package. |

16 Mooring Deployment Table

| Mooring | UKORS No. | Latitude °N | Longitude °W | Fallback (m) | Depth (m) | date | Duration | Argos ID | A/R 1 | A/R 2 |
|---------|-----------|-------------|--------------|--------------|-----------|----------|----------|---------------|-------|-------|
| EBH1 | 2012/30 | 27°13.34' | 15°25.36' | | 3039 | 16/10/12 | 0:25 | 121992 | 1351 | 251 |
| EBH1L9 | 2012/31 | 27°12.73' | 15°24.17' | | 3015 | 16/10/12 | 0:05 | 121991 | 265 | 347 |
| EBH2 | 2012/32 | 27°36.65' | 14°12.74' | | 2020 | 16/10/12 | 0:15 | 121990 | 1346 | 1534 |
| EBH3 | 2012/33 | 27°48.74' | 13°44.71' | 94 | 1423 | 17/10/12 | 1:24 | 121989 | 825 | 1345 |
| EBHi | 2012/35 | 24°55.97' | 21°16.39' | | 4495 | 23/10/12 | 0:32 | 53157 | 1533 | 1348 |
| EB1L9 | 2012/36 | 23°47.93' | 24°06.69' | 112 | 5097 | 24/10/12 | 0:04 | 93792 | 1353 | 368 |
| EB1 | 2012/37 | 23°45.27' | 24°09.39' | 361 | 5097 | 25/10/12 | 4:01 | 82952, 60211 | 1535 | 1536 |
| EBH4L4 | 2012/38 | 27°52.31' | 13°30.89' | 93 | 1009 | 28/10/12 | 0:09 | 46501 | 908 | 1242 |
| EBH4 | 2012/39 | 27°51.06' | 13°32.42' | 155 | 1057 | 28/10/12 | 1:23 | 121996 | 246 | 1354 |
| MAR3 | 2012/40 | 23°52.21' | 41°05.40' | | 5056 | 05/11/12 | 1:40 | 46491 | 824 | 925 |
| MAR3L8 | 2012/41 | 23°51.39' | 41°05.93' | | 5055 | 05/11/12 | 0:06 | 46492 | 927 | 907 |
| MAR1 | 2012/43 | 24°09.91' | 49°45.02' | 423 | 5212 | 08/11/12 | 4:08 | 121988, 82895 | 1200 | 319 |
| MAR1L8 | 2012/44 | 24°11.72' | 49°42.84' | | 5222 | 09/11/12 | 0:05 | 121997 | 822 | 1203 |
| MAR2 | 2012/45 | 24°10.66' | 49°45.77' | | 5214 | 09/11/12 | 1:11 | 53153 | 264 | 1197 |
| MAR0 | 2012/46 | 25°06.68' | 52°01.03' | | 5489 | 10/11/12 | 0:17 | 121933 | 923 | 249 |
| WB6 | 2012/47 | 26°29.65' | 70°31.36' | | 5497 | 14/11/12 | 0:15 | 121994 | 819 | 281 |
| WB1 | 2012/48 | 26°30.60' | 76°49.09' | 78 | 1369 | 17/11/12 | 2:30 | 46493, 42145 | 1201 | 1194 |
| WB4L9 | 2012/49 | 26°28.38' | 75°42.30' | 236 | 4691 | 18/11/12 | 0:04 | 53130 | 322 | 256 |
| WB4 | 2012/50 | 26°28.74' | 75°42.25' | 345 | 4695 | 19/11/12 | 5:15 | 53218, 111853 | 910 | 316 |
| WB2 | 2012/51 | 26°30.98' | 76°44.32' | 264 | 3920 | 20/11/12 | 3:58 | 46499, 22442 | 917 | 323 |
| WB2L9 | 2012/52 | 26°30.43' | 76°44.43' | -250 | 3889 | 20/11/12 | 0:04 | 121995 | 928 | 920 |
| WBH2 | 2012/53 | 26°29.14' | 76°37.76' | | 4714 | 22/11/12 | 02:44 | 46485 | 827 | 687 |
| WBADCP | 2012/54 | 26°31.51' | 76°52.06' | | 615 | 22/11/12 | 00:03 | 46494 | 906 | 497 |
| WBAL4 | 2012/55 | 26°31.48' | 76°52.56' | | 493 | 22/11/12 | 00:06 | 111852 | 1195 | 320 |
| WBP1 | 2012/56 | 27°06.10' | 76°36.71' | | 4102 | 23/11/12 | 00:01 | n/a | n/a | n/a |
| NOG | 2012/42 | 23°46.25' | 24°05.92' | | 4241 | 05/11/12 | 1:19 | n/a | 1350 | n/a |

17 Mooring Recovery Table

| Mooring Name | Sequential Mooring Number | UKORS Mooring Number | Deployment Cruise | Lat (°N) | Lon (°W) | Deployment Date | Recovery Date |
|--------------|---------------------------|----------------------|-------------------|-----------|-----------|-----------------|---------------|
| EBH1 | 8 | 2011/24 | JC064 | 27°08.61' | 15°22.66' | 06/10/11 | 15/10/12 |
| EBH1L7 | 7 | 2011/05-25 | D359 | 27°16.61' | 15°24.94' | 10/01/11 | 15/10/12 |
| EBH2 | 8 | 2011/27 | JC064 | 27°36.88' | 14°12.65' | 12/09/11 | 16/10/12 |
| EBH3 | 8 | 2011/38 | JC064 | 27°48.30' | 13°44.81' | 12/09/11 | 17/10/12 |
| EBH4 | 8 | 2011/32 | JC064 | 24°55.98' | 21°16.39' | 15/09/11 | 23/10/12 |
| EB1 | 10 | 2011/22 | JC064 | 23°45.46' | 24°09.31' | 17/09/11 | 24/10/12 |
| EB1L7 | 7 | 2011/02 | JC064 | 23°48.05' | 24°06.69' | 06/01/11 | 24/10/12 |
| EBH4L2 | 2 | 2011/10 | D359 | 27°52.30' | 13°30.81' | 12/01/11 | 28/10/12 |
| EBH4 | 9 | 2011/29 | JC064 | 27°51.01' | 13°32.45' | 11/09/11 | 28/10/12 |
| EBH5 | 7 | 2011/31 | JC064 | 27°50.56' | 13°32.65' | 11/09/11 | 28/10/12 |
| MAR3L6 | 6 | 2010/27 | D359 | 23°51.76' | 41°05.76' | 31/12/10 | 05/11/12 |
| MAR3 | 8 | 2011/37 | JC064 | 23°48.42' | 41°05.90' | 21/09/11 | 05/11/12 |
| NOGST | | | JC064 | 23°46.26' | 41°05.93' | 22/09/11 | 05/11/12 |
| MAR2 | 8 | 2011/36 | JC064 | 24°11.10' | 49°45.39' | 25/09/11 | 07/11/12 |
| MAR1L6 | 6 | 2010/27 | D359 | 24°12.23' | 49°43.68' | 25/12/10 | LOST |
| MAR1 | 8 | 2011/34 | JC064 | 24°09.93' | 49°45.00' | 25/09/11 | 08/11/12 |
| MAR0 | 5 | 2011/33 | JC064 | 25°06.28' | 52°00.61' | 26/09/11 | LOST |
| WB6 | 6 | 2012/01 | RB1201 | 26°29.70' | 70°31.34' | 17/02/12 | 14/11/12 |
| WB1 | 9 | 2012/08 | RB1201 | 26°29.97' | 76°44.82' | 28/02/12 | 17/11/12 |
| WB4 | 9 | 2012/02 | RB1201 | 26°28.71' | 75°41.98' | 23/02/12 | 18/11/12 |
| WB4L7 | 7 | 2011/20 | KN200-4 | 26°29.20' | 75°48.44' | 23/04/11 | 18/11/12 |
| WB2 | 10 | 2015/05 | RB1201 | 26°30.72' | 76°43.98' | 27/02/12 | 20/11/12 |
| WB2L7 | 7 | 2011/19 | KN200-4 | 26°30.50' | 76°44.60' | 28/04/11 | 20/11/12 |
| WBH2 | 6 | 2012/04 | RB1201 | 26°28.91' | 76°37.44' | 25/02/12 | 21/11/12 |
| WBAL2 | 2 | 2011/21 | KN200-4 | 26°31.57' | 76°52.55' | 30/04/11 | 21/11/12 |
| WBADCP | 9 | 2012/06 | RB1201 | 26°31.49' | 76°52.08' | 27/02/12 | 21/11/12 |

18 Acoustic Release Summary

| Serial No | Type | Previous Location | Current Location | Deployed | Serviced | New Batts | Bench tested | Wire tested | Depth tested |
|-----------|-------|-------------------|------------------|----------|----------|-----------|--------------|-------------|--------------|
| 1353 | AR861 | NOC | EB1L9 | 24/10/12 | YES | YES | YES | YES | 5000 |
| 265 | AR861 | NOC | EBH1L9 | 16/10/12 | YES | YES | YES | YES | 5000 |
| 1347 | AR861 | NOC | EBH1L9 | 16/10/12 | YES | YES | YES | YES | 5000 |
| 368 | AR861 | NOC | EB1L9 | 24/10/12 | YES | YES | YES | YES | 5000 |
| 246 | AR861 | NOC | EBH4 | 28/10/12 | YES | YES | YES | YES | 5000 |
| 1354 | AR861 | NOC | EBH4 | 28/10/12 | YES | YES | YES | YES | 5000 |
| 1535 | AR861 | NOC | EB1 | 25/10/12 | YES | YES | YES | YES | 5000 |
| 1533 | AR861 | NOC | ENHI | 23/10/12 | YES | YES | YES | YES | 5000 |
| 1348 | AR861 | NOC | EBH1 | 23/10/12 | YES | YES | YES | YES | 5000 |
| 1351 | AR861 | NOC | EBH1 | 16/10/12 | YES | YES | YES | YES | 5000 |
| 251 | AR861 | NOC | EBH1 | 16/10/12 | YES | YES | YES | YES | 5000 |
| 1536 | AR861 | NOC | EB1 | 25/10/12 | YES | YES | YES | YES | 5000 |
| 320 | AR861 | EBH3L1 | WBAL4 | | YES | YES | YES | YES | 3000 |
| 1350 | AR861 | EBH3L1 | NOG | 05/11/12 | YES | YES | YES | YES | 3000 |
| 1345 | AR861 | NOC | EBH3 | 17/10/12 | YES | YES | YES | YES | 3000 |
| 1346 | AR861 | NOC | EBH2 | 16/10/12 | YES | YES | YES | YES | 3000 |
| 825 | AR861 | NOC | EBH3 | 17/10/12 | YES | YES | YES | YES | 3000 |
| 907 | AR861 | NOC | MAR3L8 | 05/11/12 | YES | YES | YES | YES | 5000 |
| 1534 | AR861 | NOC | EBH2 | 16/10/12 | YES | YES | YES | YES | 3000 |
| 824 | AR861 | EBH1L7 | MAR3 | 05/11/12 | YES | YES | YES | YES | 5000 |
| 281 | AR861 | EBH1L7 | WB6 | 14/11/12 | YES | YES | YES | YES | 5600 |
| 827 | AR861 | EBH1 | WBH2 | 19/11/12 | YES | YES | YES | YES | 5600 |
| 1200 | AR861 | EBH1 | MAR1 | 08/11/12 | YES | YES | YES | YES | 5000 |
| 1242 | AR861 | EBH2 | EBH4L4 | 28/10/12 | YES | YES | YES | YES | 5000 |
| 927 | AR861 | EBH2 | MAR3L8 | 05/11/12 | YES | YES | YES | YES | 5000 |

| | | | | | | | | | |
|------|-------|--------|--------|----------|-----|-----|-----|-----|------|
| 925 | AR861 | EBH3 | MAR3 | 05/11/12 | YES | YES | YES | YES | 5000 |
| 908 | AR861 | EBH3 | EBH4L4 | 28/10/12 | YES | YES | YES | YES | 5000 |
| 819 | AR861 | EBHI | DISCO | | YES | YES | YES | YES | 5600 |
| 923 | AR861 | EBHI | MAR0 | 10/11/12 | YES | YES | YES | YES | 5600 |
| 319 | AR861 | EB1L7 | MAR1 | 08/11/12 | YES | YES | YES | YES | 5000 |
| 924 | AR861 | EB1L7 | DISCO | CORRODED | | | | | |
| 1203 | AR861 | EB1 | MAR1L8 | 09/11/12 | YES | YES | YES | YES | 5000 |
| 1197 | AR861 | EB1 | MAR2 | 09/11/12 | YES | YES | YES | YES | 5000 |
| 249 | AR861 | EBH5 | MAR0 | 10/11/12 | YES | YES | YES | YES | 5600 |
| 256 | AR861 | EBH5 | WB4L9 | 19/11/12 | YES | YES | YES | YES | 5000 |
| 323 | AR861 | EBH4L2 | WB2 | | YES | YES | YES | YES | 5000 |
| 687 | AR861 | EBH4L2 | WBH2 | 19/11/12 | YES | YES | YES | YES | 5600 |
| 264 | AR861 | EBH4 | MAR2 | 09/11/12 | YES | YES | YES | YES | 5000 |
| 906 | AR861 | EBH4 | WBADCP | 22/11/12 | YES | YES | YES | YES | 5000 |
| 917 | AR861 | MAR3 | WB2 | | YES | YES | YES | YES | 5000 |
| 322 | AR861 | MAR3 | WB4L9 | 19/11/12 | YES | YES | YES | YES | 5000 |
| 497 | AR861 | MAR3L6 | WBADCP | 22/11/12 | YES | YES | YES | YES | 5000 |
| 1195 | AR861 | MAR3L6 | WBAL4 | | YES | YES | YES | YES | 5000 |
| 822 | AR861 | NOG | MAR1L8 | 09/11/12 | YES | YES | YES | YES | 5000 |
| 928 | AR861 | MAR2 | WB2L9 | | YES | YES | YES | YES | 5400 |
| 1194 | AR861 | MAR2 | WB1 | | YES | YES | YES | YES | 5400 |
| 920 | AR861 | MAR1 | WB2L9 | | YES | YES | YES | YES | 5400 |
| 316 | AR861 | MAR1 | WB4 | | YES | YES | YES | YES | 5400 |
| 163 | RT661 | MAR1L6 | MAR1L6 | N/R | | | | | |
| 1196 | AR861 | MAR1L6 | MAR1L6 | N/R | | | | | |
| 826 | AR861 | MAR0 | MAR0 | N/R | | | | | |
| 1199 | AR861 | MAR0 | MAR0 | N/R | | | | | |
| 1201 | AR861 | WB6 | WB1 | | YES | YES | YES | YES | 5400 |
| 910 | AR861 | WB6 | WB4 | | YES | YES | YES | YES | 5400 |

| | | | |
|------|-------|--------|-------|
| 1464 | AR861 | WBADCP | DISCO |
| 821 | AR861 | WBADCP | DISCO |
| 1461 | AR861 | WB1 | DISCO |
| 823 | AR861 | WB1 | DISCO |
| 1406 | AR861 | WB2 | DISCO |
| 324 | AR861 | WB2 | DISCO |
| 918 | AR861 | WB2L7 | DISCO |
| 916 | AR861 | WB2L7 | DISCO |
| 1465 | AR861 | WB4 | DISCO |
| 1463 | AR861 | WB4 | DISCO |
| 1349 | AR861 | WB4L7 | DISCO |
| 358 | AR861 | WB4L7 | DISCO |
| 1352 | AR861 | WBAL2 | DISCO |
| 364 | AR861 | WBAL2 | DISCO |
| 216 | RT661 | WBH2 | DISCO |
| 1405 | AR861 | WBH2 | DISCO |

19 RAPID mooring and hydrographic cruises

Gerard McCarthy

| Cruise | Vessel | Date | Objectives | Cruise Report |
|---------|----------------------|----------------|---|--|
| D277 | RRS Discovery | Feb - Mar 2004 | Initial Deployment of Eastern Boundary and Mid-Atlantic Ridge moorings | RRS Discovery Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005 |
| D278 | RRS Discovery | Mar-04 | Initial Deployment of UK and US Western Boundary Moorings | RRS Discovery Cruise D277 and D278. Southampton Oceanography Centre Cruise Report, No 53, 2005 |
| P319 | RV Poseidon | Dec-04 | Emergency deployment of replacement EB2 following loss | Appendix in RRS Charles Darwin Cruise CD170 and RV Knorr Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006 |
| CD170 | RRS Charles Darwin | Apr-05 | Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings | RRS Charles Darwin Cruise CD170 and RV Knorr Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006 |
| KN182-2 | RV Knorr | May-05 | Service and redeployment of UK and US Western Boundary Moorings and Western Boundary Time Series (WBTS) hydrography section | RRS Charles Darwin Cruise CD170 and RV Knorr Cruise KN182-2. National Oceanography Centre Southampton Cruise Report, No. 2, 2006 |
| CD177 | RRS Charles Darwin | Nov-05 | Service and redeployment of key Eastern Boundary moorings | RRS Charles Darwin Cruise CD177. National Oceanography Centre Southampton Cruise Report, No. 5, 2006 |
| WS05018 | RV F.G. Walton Smith | Nov 05 | Emergency recovery of drifting WB1 mooring | No report published |

| | | | | |
|--------|--------------------|----------------|---|--|
| RB0602 | RV Ronald H. Brown | Mar-06 | Service and redeployment of UK Western Boundary moorings and WBTS hydrography section | RV Ronald H. Brown Cruise RB0602 and RRS Discovery Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007 |
| D304 | RRS Discovery | May - Jun 2006 | Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings | RV Ronald H. Brown Cruise RB0602 and RRS Discovery Cruise D304. National Oceanography Centre Southampton Cruise Report, No. 16, 2007 |
| P343 | RV Poseidon | Oct 06 | Service and redeployment of key Eastern Boundary moorings | RS Poseidon Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008. |
| P345 | RV Poseidon | Dec 06 | Emergency redeployment of EB1 and EB2 following problems on P343 | RS Poseidon Cruises P343 and P345. National Oceanography Centre Southampton Cruise Report No. 28, 2008. |
| SJ06 | RV Seward Johnson | Sep - Oct 2006 | Recovery and redeployment of WB2 and US Western Boundary moorings, and WBTS hydrography section | Appendix G in RV Ronald H. Brown Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29 |
| RB0701 | RV Ronald H. Brown | Mar - Apr 2007 | Service and redeployment of UK Western Boundary moorings and WBTS hydrography section | RV Ronald H. Brown Cruise RB0701. National Oceanography Centre, Southampton Cruise Report, No 29 |
| D324 | RRS Discovery | Oct - Nov 2007 | Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings | RRS Discovery Cruise D324, National Oceanography Centre, Southampton Cruise Report, No 34 |
| SJ0803 | RV Seward Johnson | Apr-08 | Service and redeployment of the Western Boundary moorings | RV Seward Johnson Cruise SJ0803, National Oceanography Centre, Southampton Cruise Report, No 37 |
| D334 | RRS Discovery | Oct-Nov 2008 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | RRS Discovery D344, National Oceanography Centre, Southampton, Cruise Report No. 38, 2009 |

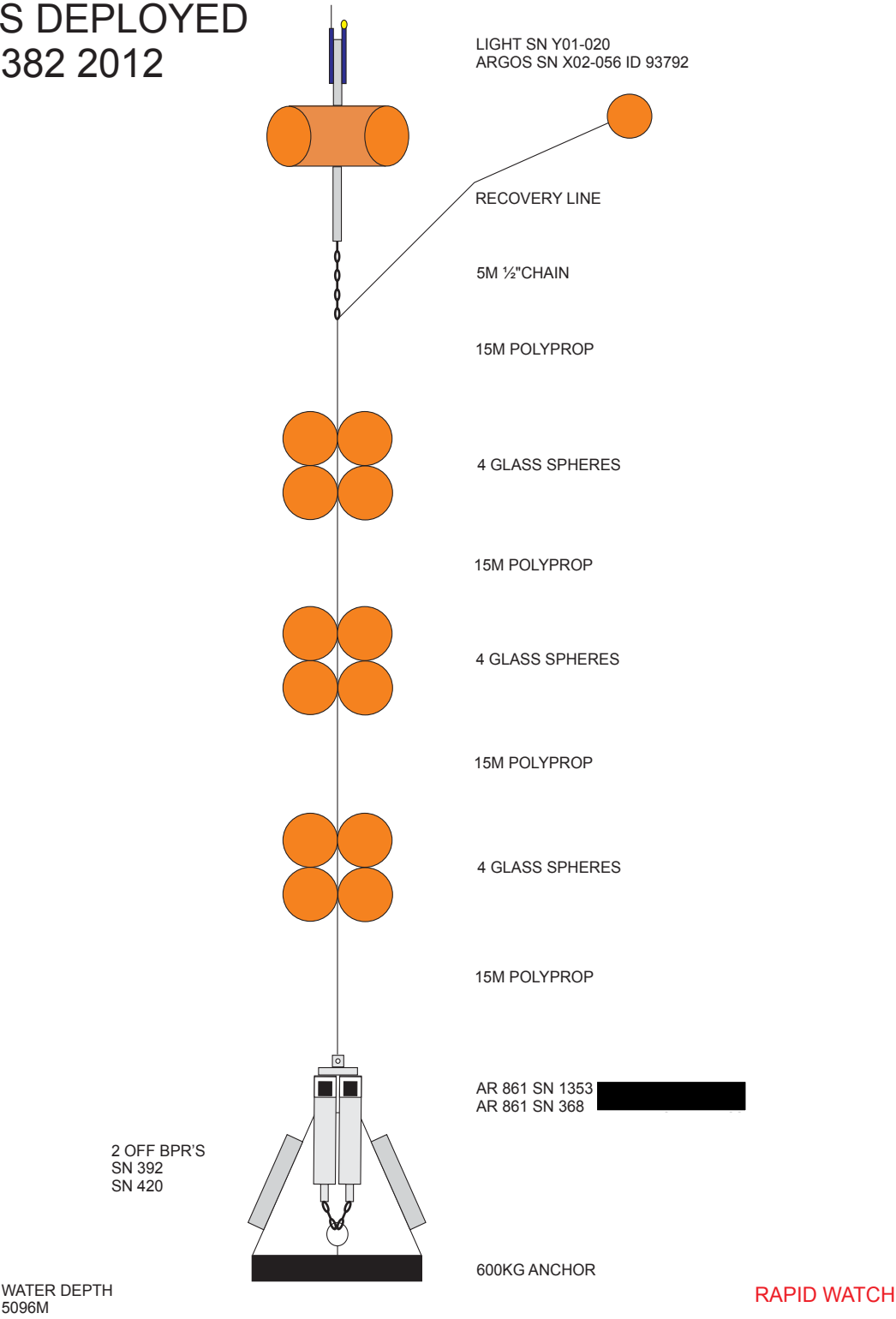
| | | | | |
|---------|--------------------|-------------------------------|--|--|
| RB0901 | RV Ronald H. Brown | April - May 2009 | Service and redeployment of the UK and US Western Boundary moorings and WBTS hydrography section | RV Ronald H. Brown Cruise RB0901, National Oceanography Centre, Southampton Cruise Report, No 39, 2009 |
| D344 | RRS Discovery | Oct - Nov 2009 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | RRS Discovery Cruise, D334, National Oceanography Centre, Southampton Cruise Report No. 51, 2010 |
| D345 | RRS Discovery | Nov - Dec 2009 | Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section | No cruise report to be published |
| OC459-1 | RV Oceanus | Apr-10 | Service and redeployment of the Western Boundary moorings | RV Oceanus Cruise OC459-1, National Oceanography Centre, Cruise Report, No. 1, 2011 |
| D359 | RRS Discovery | Dec 2010 - Jan 2011 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | National Oceanography Centre, Cruise Report No. 09, 2012 |
| KN200-4 | RV Knorr | April 2011 - May 2011 | Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section | National Oceanography Centre, Cruise Report No. 07, 2012 |
| JC064 | RRS James Cook | September 2011 - October 2011 | Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings | National Oceanography Centre, Cruise Report No. 14, 2012 |
| RB1201 | RV Ronald H Brown | February 2012 | Recovery and redeployment of UK Western Boundary moorings, and WBTS hydrography section | National Oceanography Centre, Cruise Report No. 19, 2012 |

| | | | | |
|--------|---------------|-------------------------------|--|--|
| AB1209 | RV Endeavor | September 2012 - October 2012 | Recovery and redeployment of US Western Boundary moorings and WBTS hydrography section | R/V Endeavor Cruise EN-517 Cruise Report |
| Di382 | RRS Discovery | October - November 2012 | Recovery and redeployment of full RAPID array | This Report |

20 Deployed Mooring Diagrams

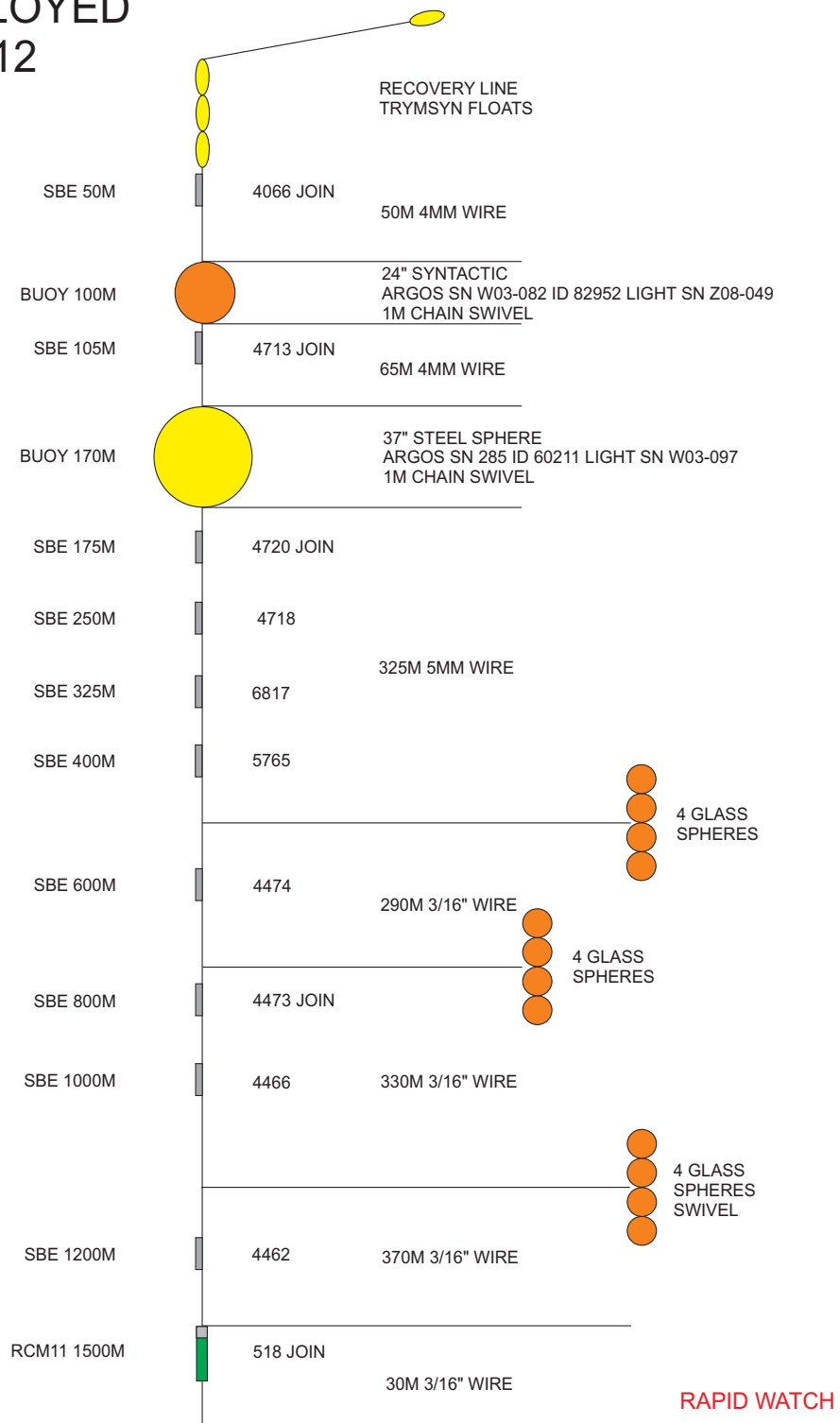
Rob McLachlan

EB1L9
AS DEPLOYED
D382 2012



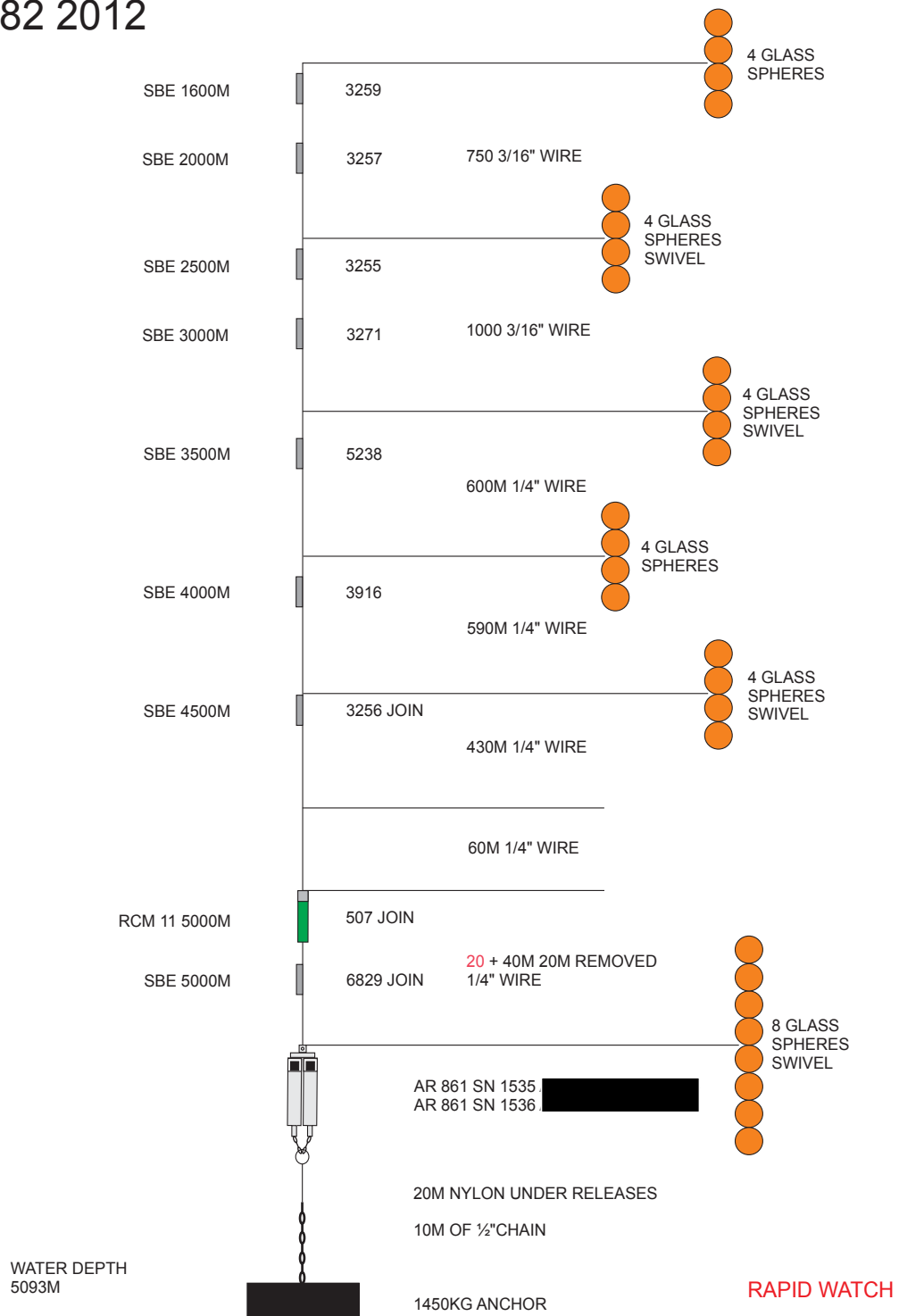
EB 1 AS DEPLOYED D382 2012

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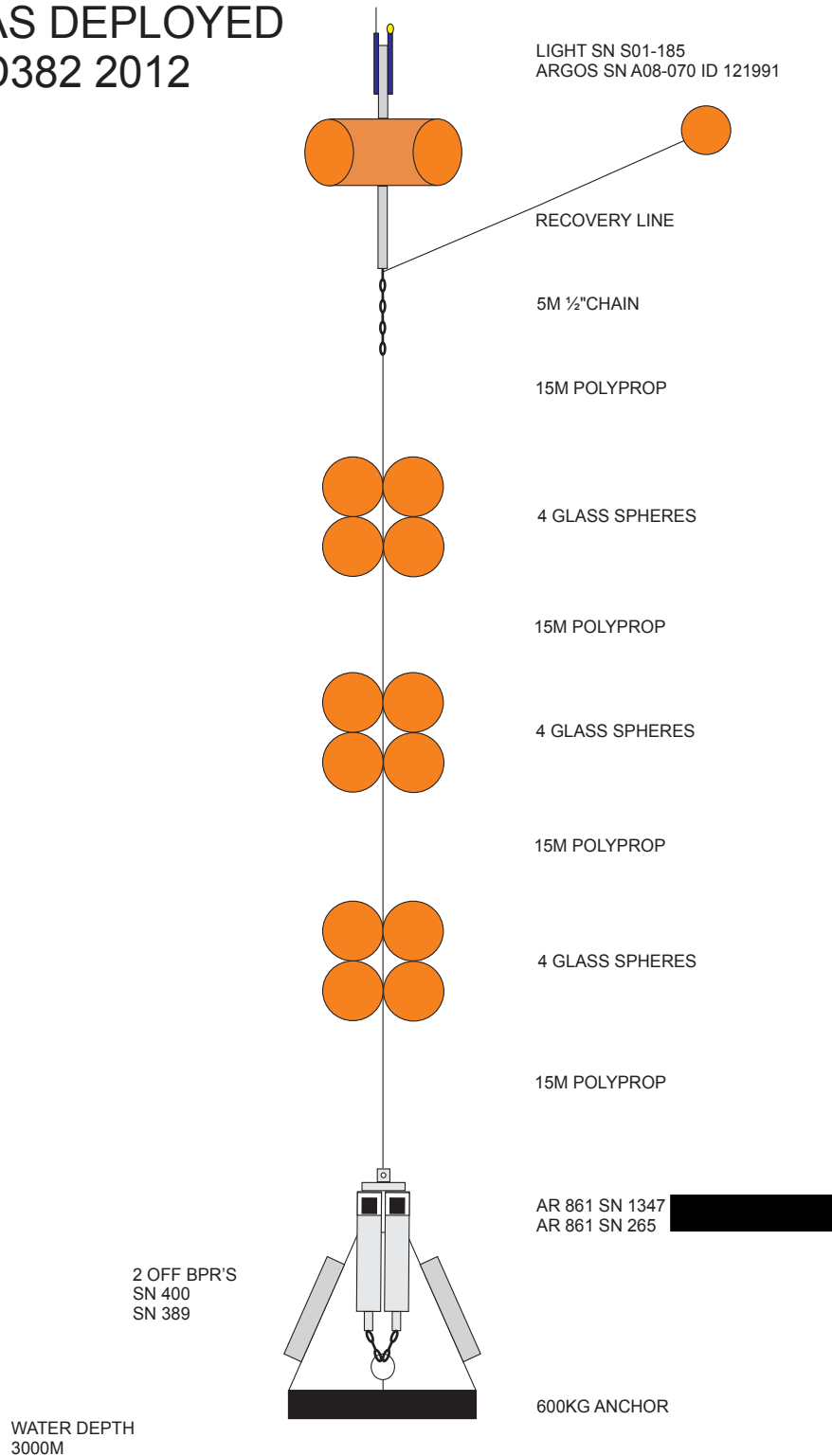


EB 1 AS DEPLOYED D382 2012

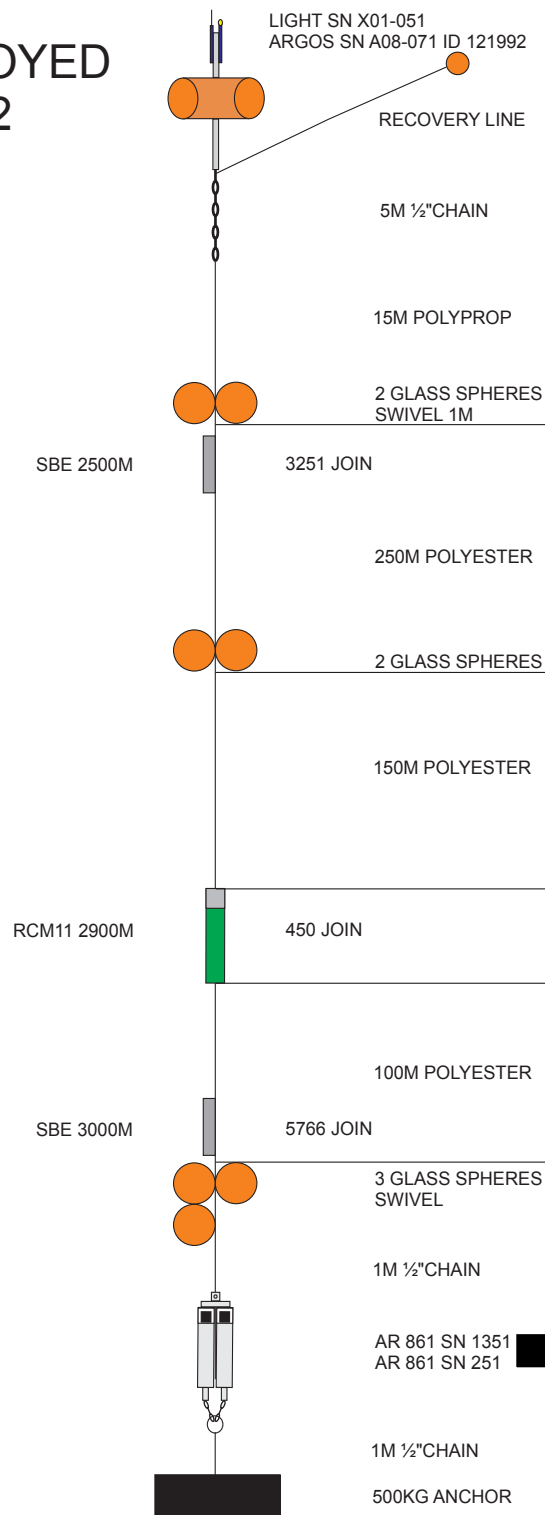
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EBH1L9
AS DEPLOYED
D382 2012



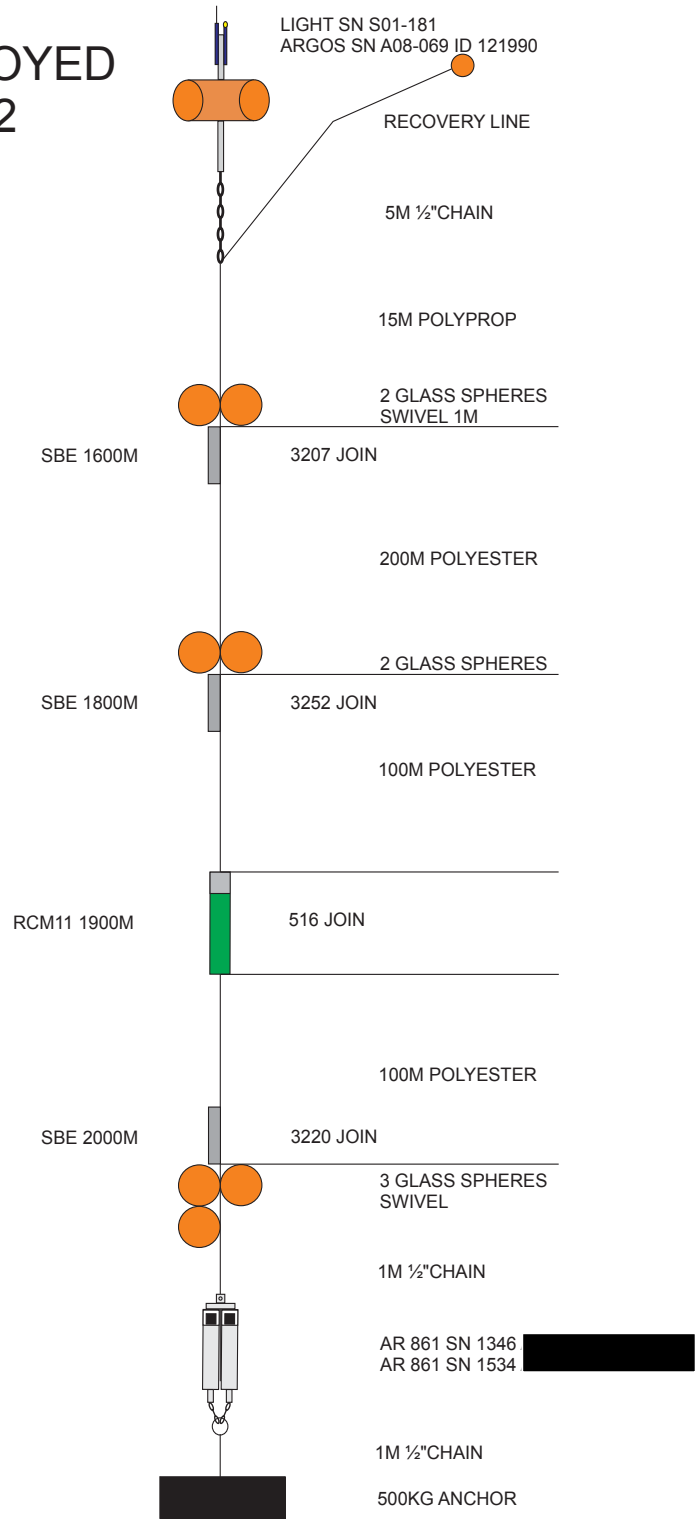
EBH1 AS DEPLOYED D382 2012



WATER DEPTH
3012M CORR

RAPID WATCH

EBH2
AS DEPLOYED
D382 2012



WATER DEPTH
2023M CORR

RAPID WATCH

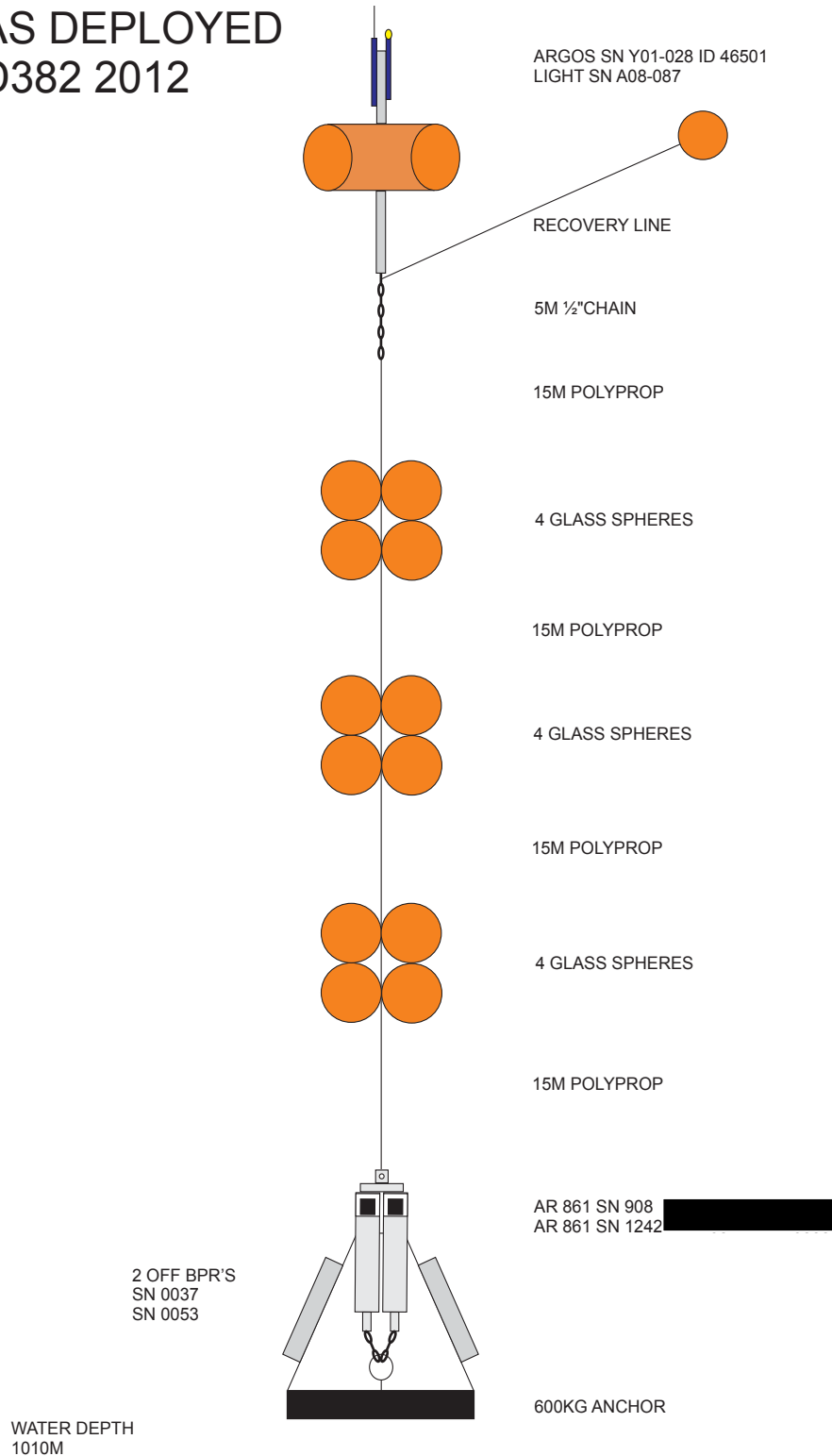
EBH3 AS DEPLOYED D382 2012

WATER DEPTH
1400M CORR



RAPID WATCH

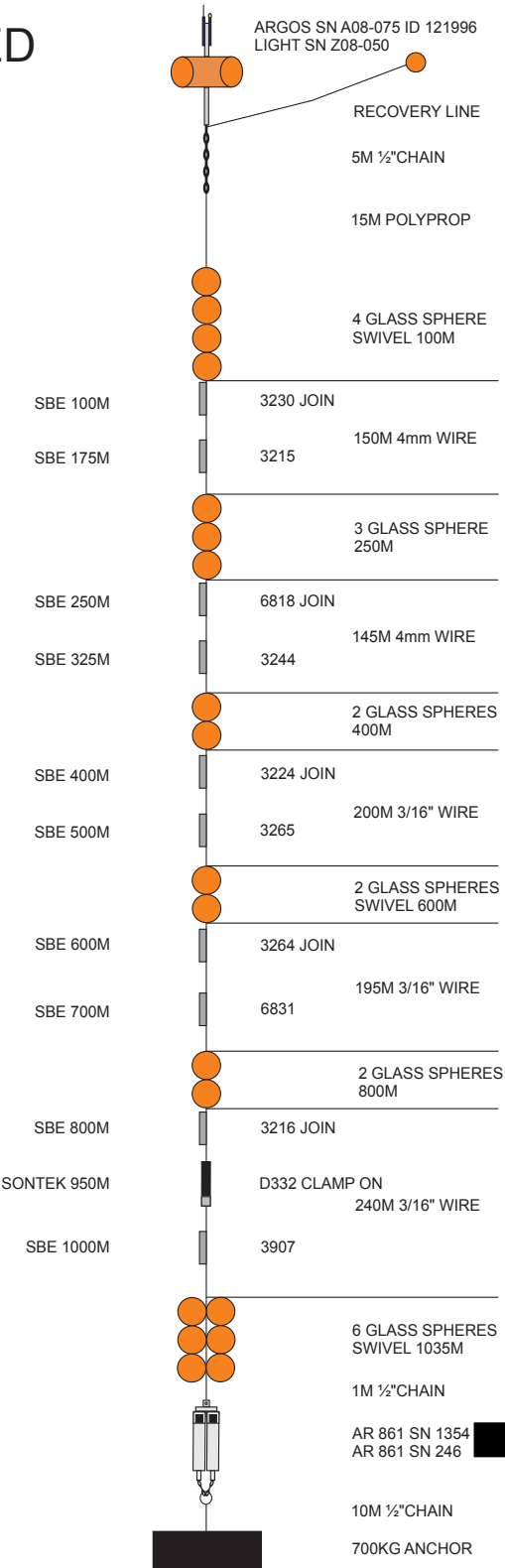
EBH4L4
AS DEPLOYED
D382 2012



RAPID WATCH

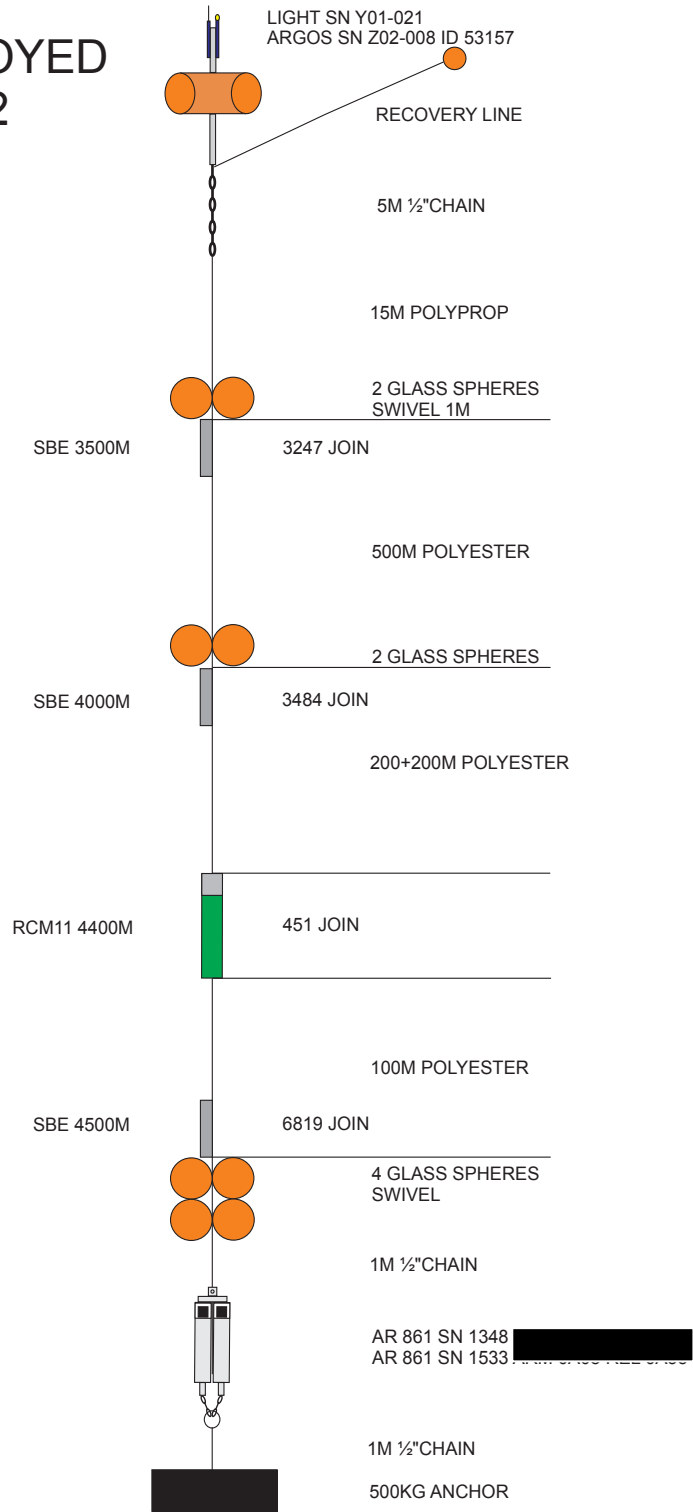
EBH4
AS DEPLOYED
D382 2012

WATER DEPTH
1050M CORR



RAPID WATCH

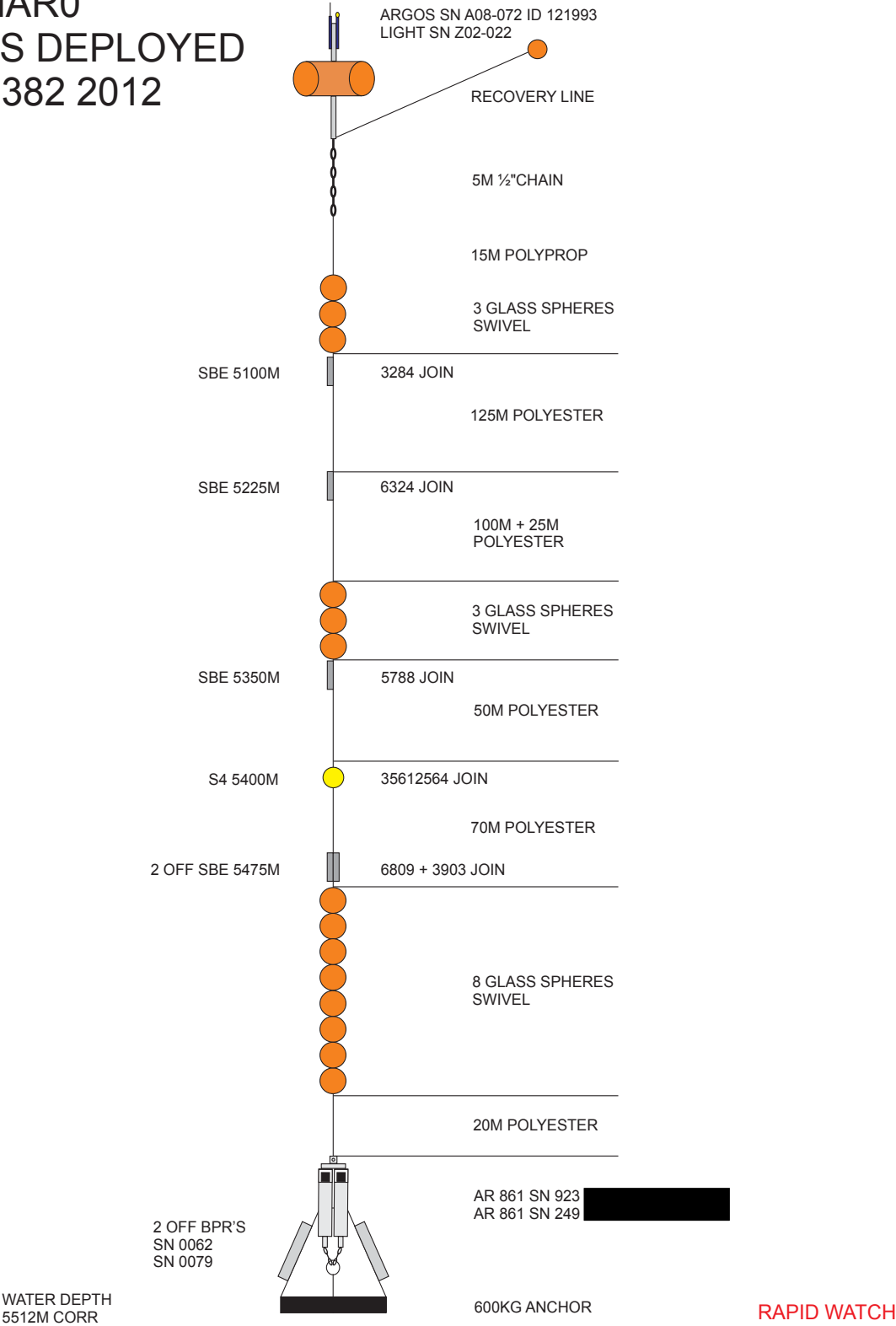
EBHi
AS DEPLOYED
D382 2012



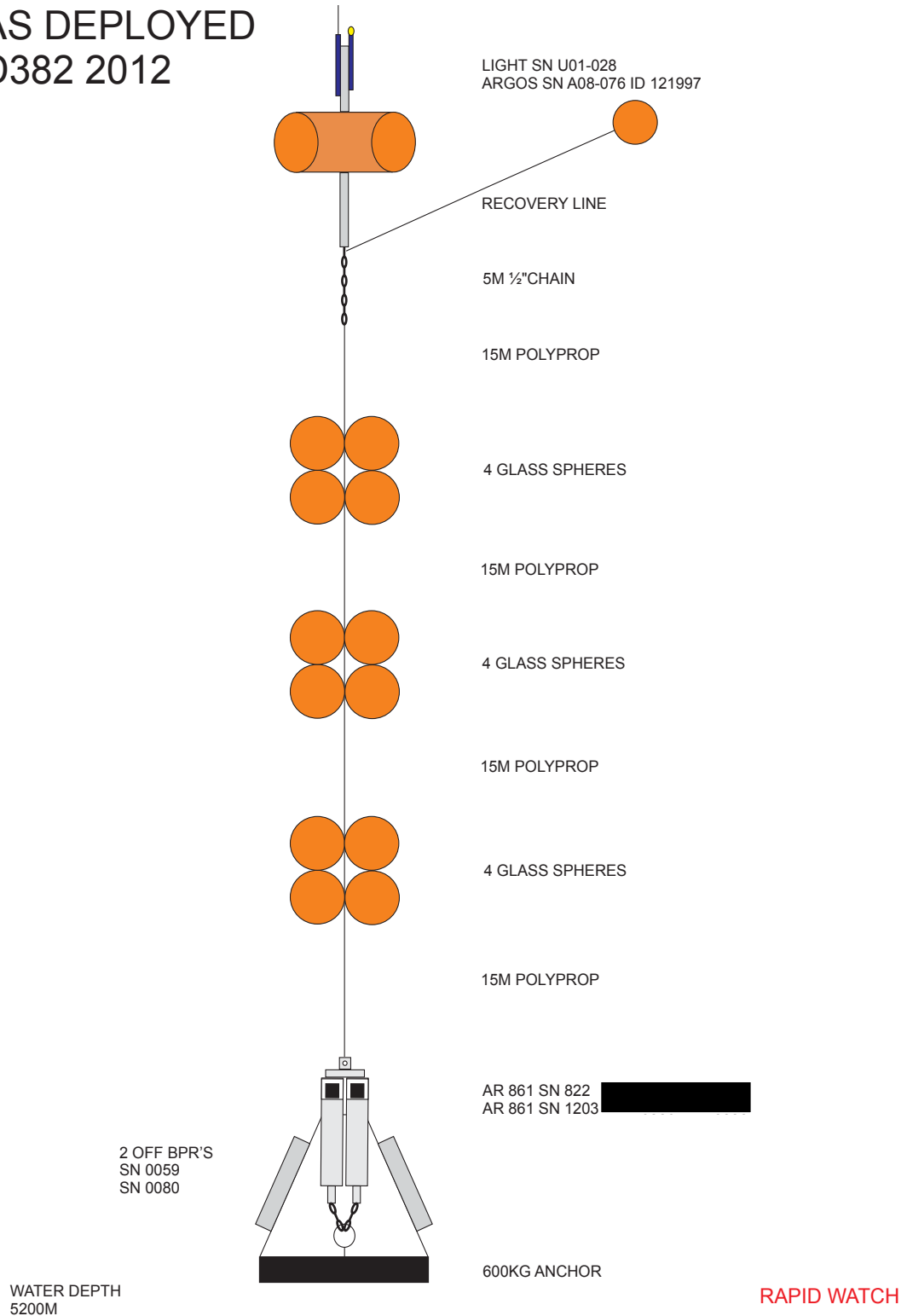
WATER DEPTH
4505M CORR

RAPID WATCH

MAR0
AS DEPLOYED
D382 2012

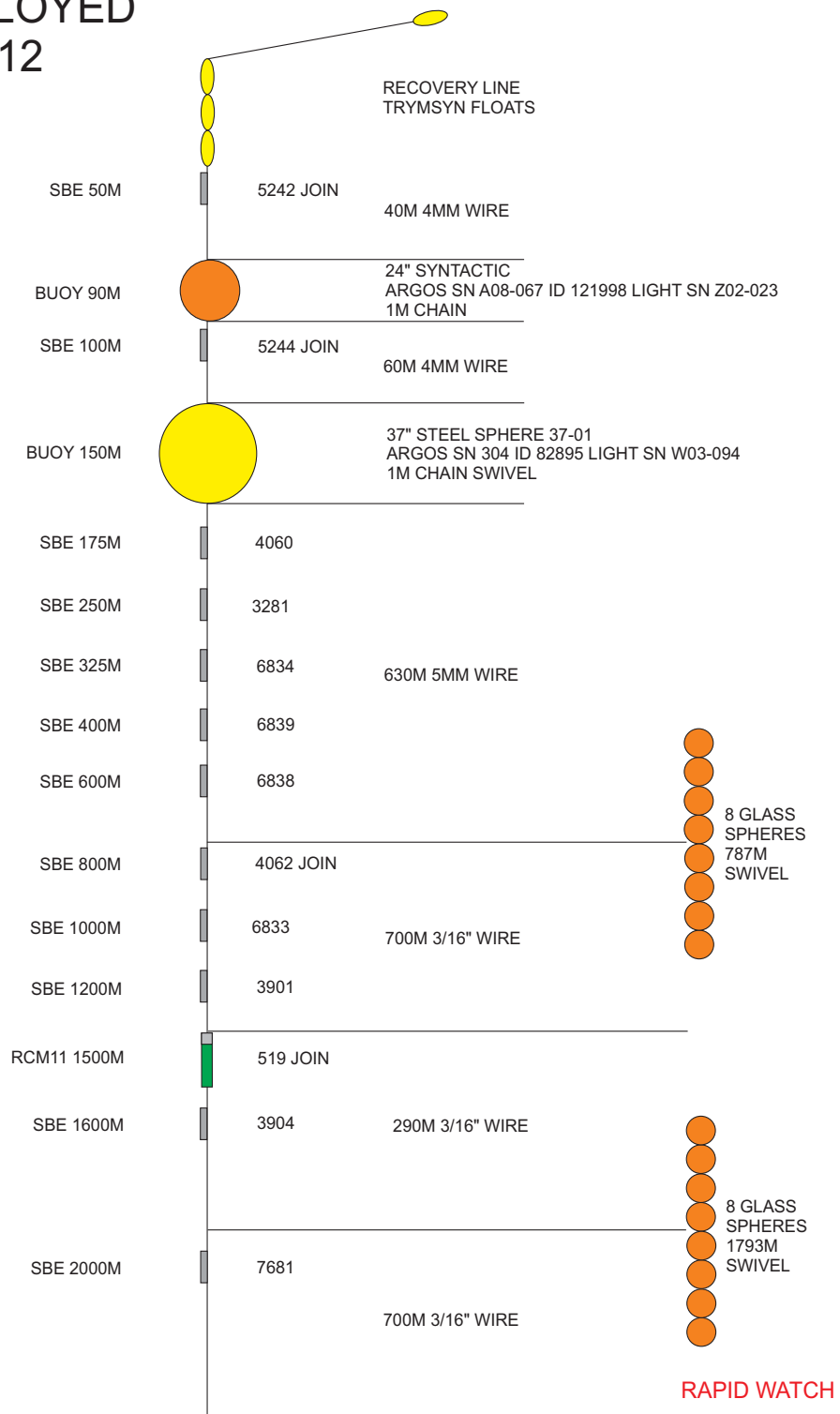


MAR1L8
AS DEPLOYED
D382 2012



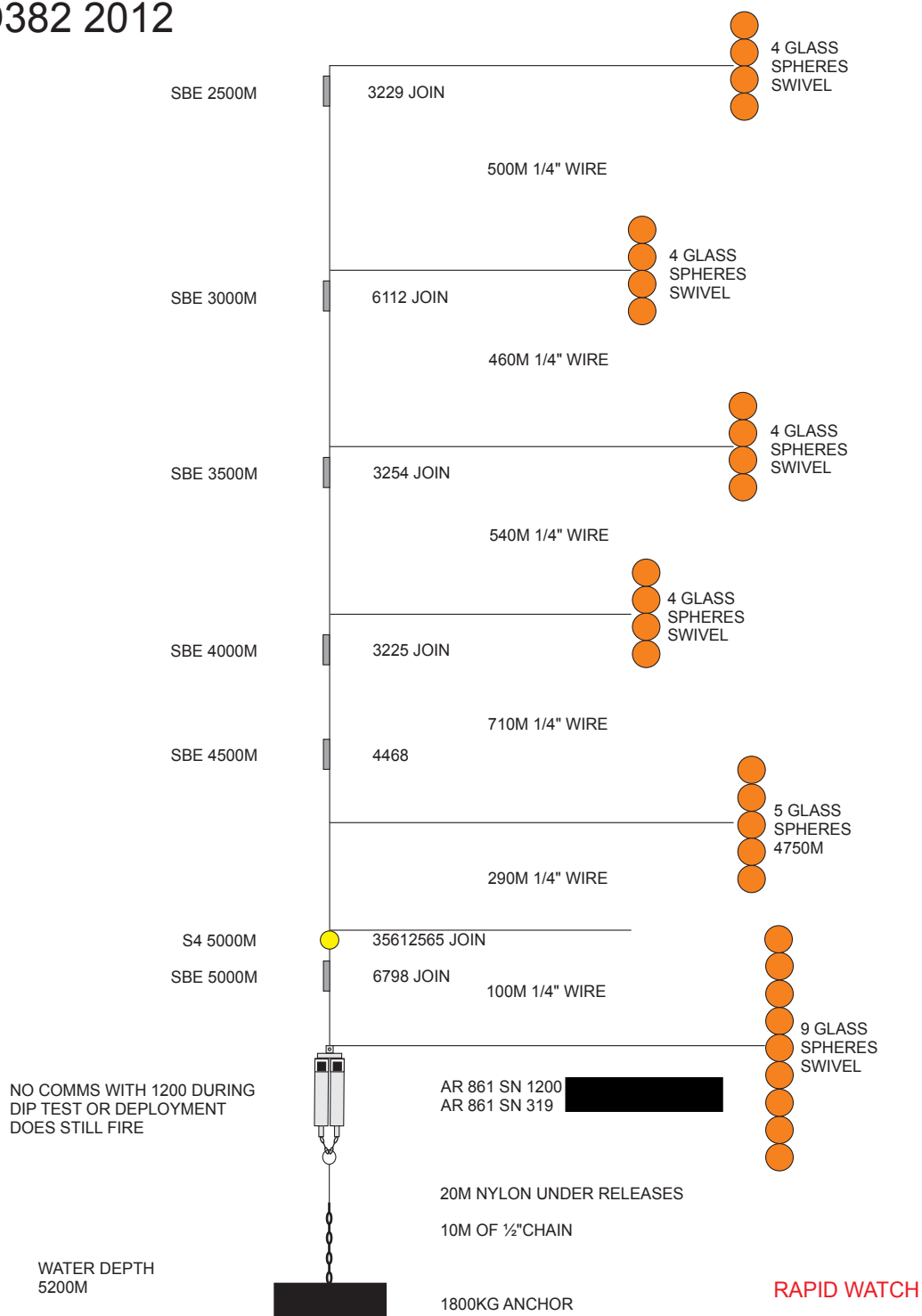
MAR 1 AS DEPLOYED D382 2012

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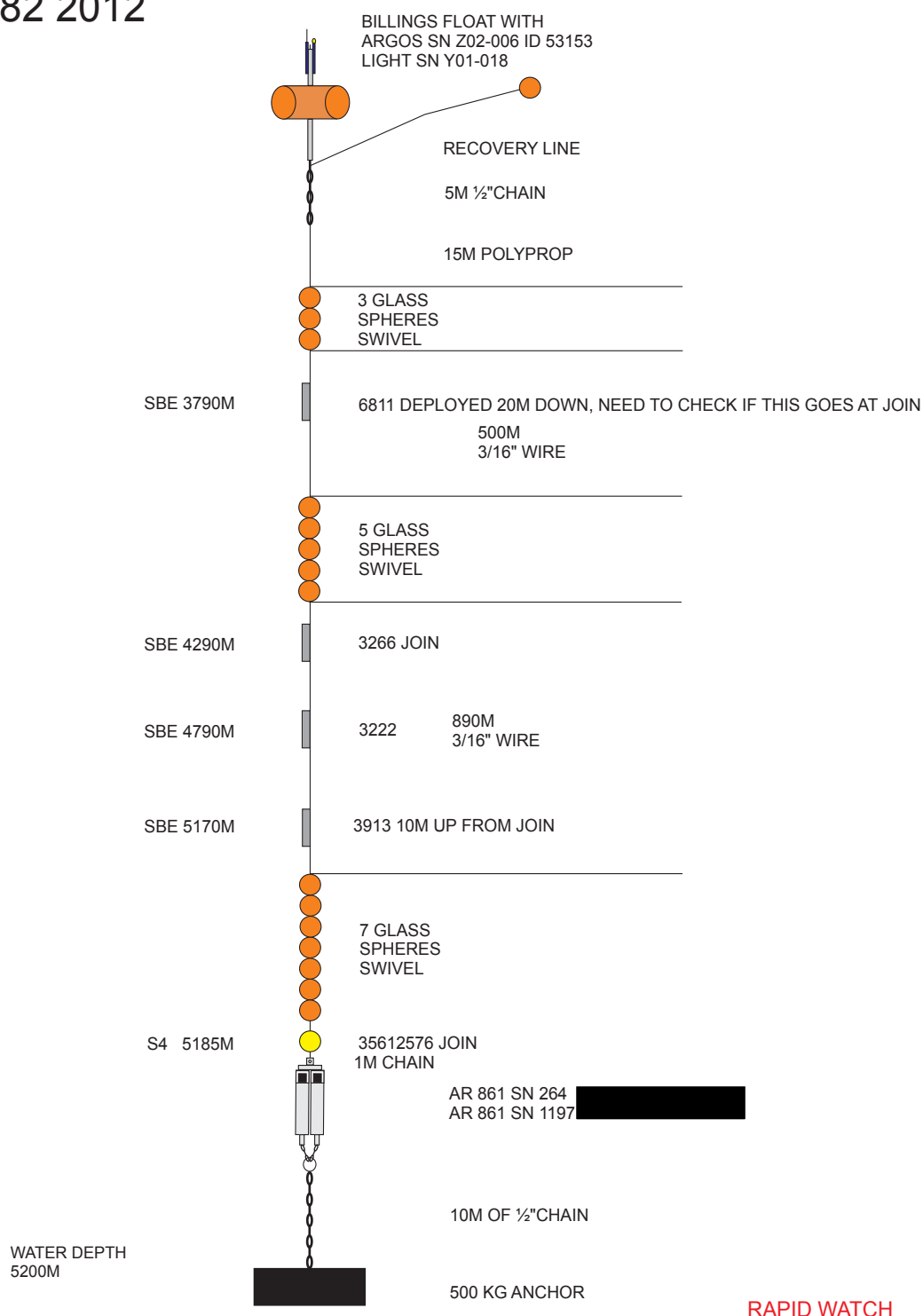


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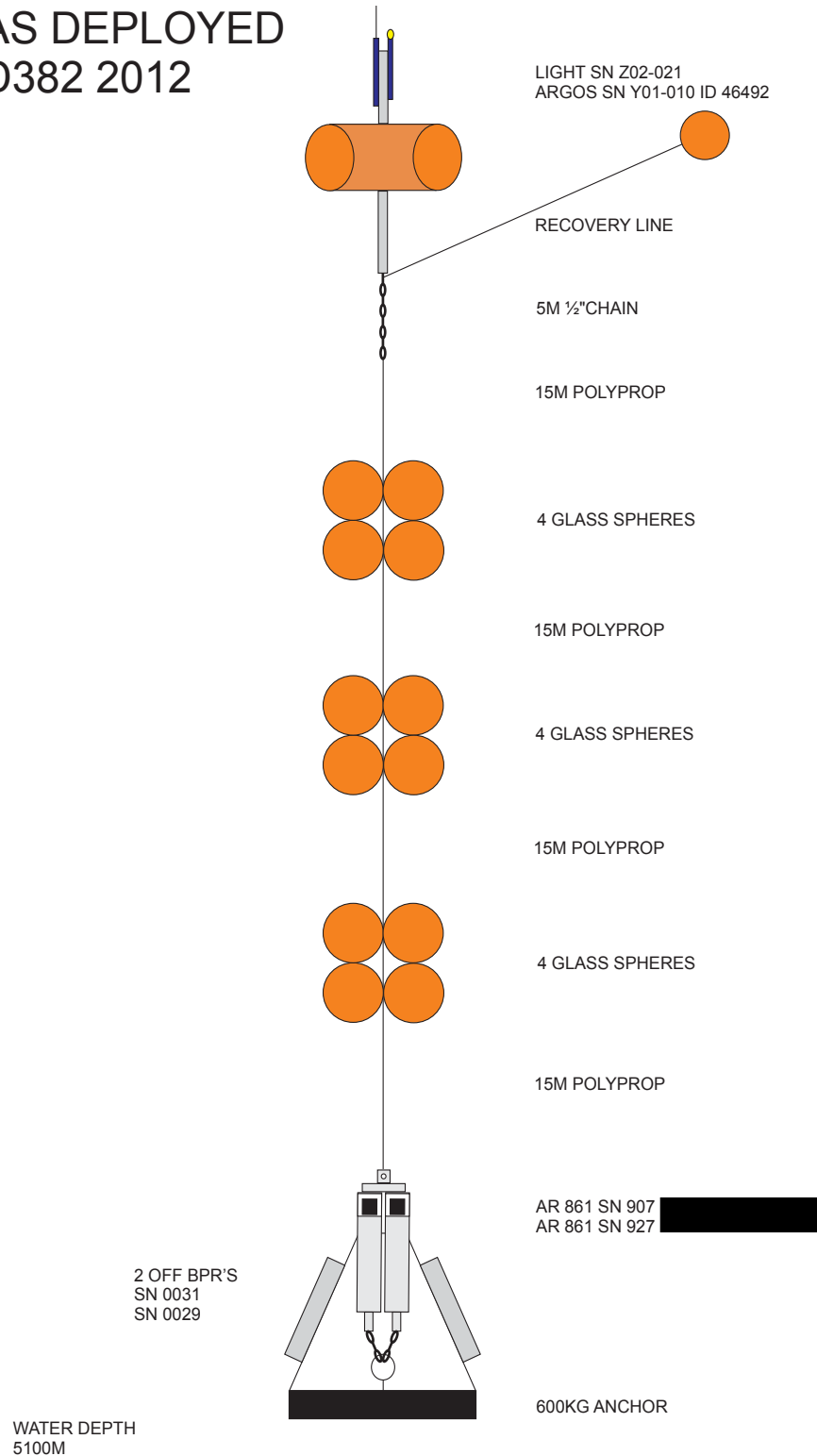
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MAR 2
AS DEPLOYED
D382 2012

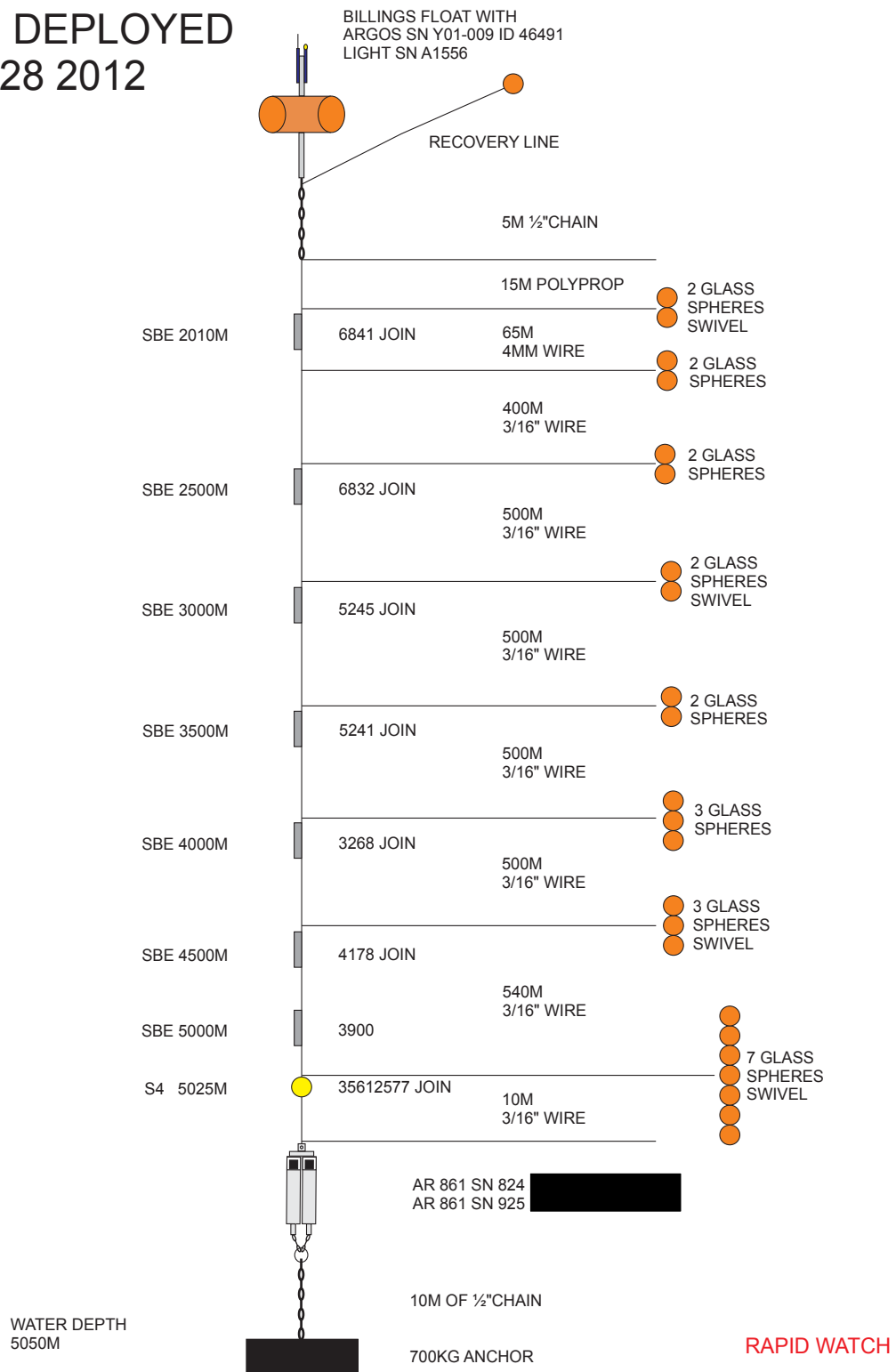


MAR3L8
AS DEPLOYED
D382 2012



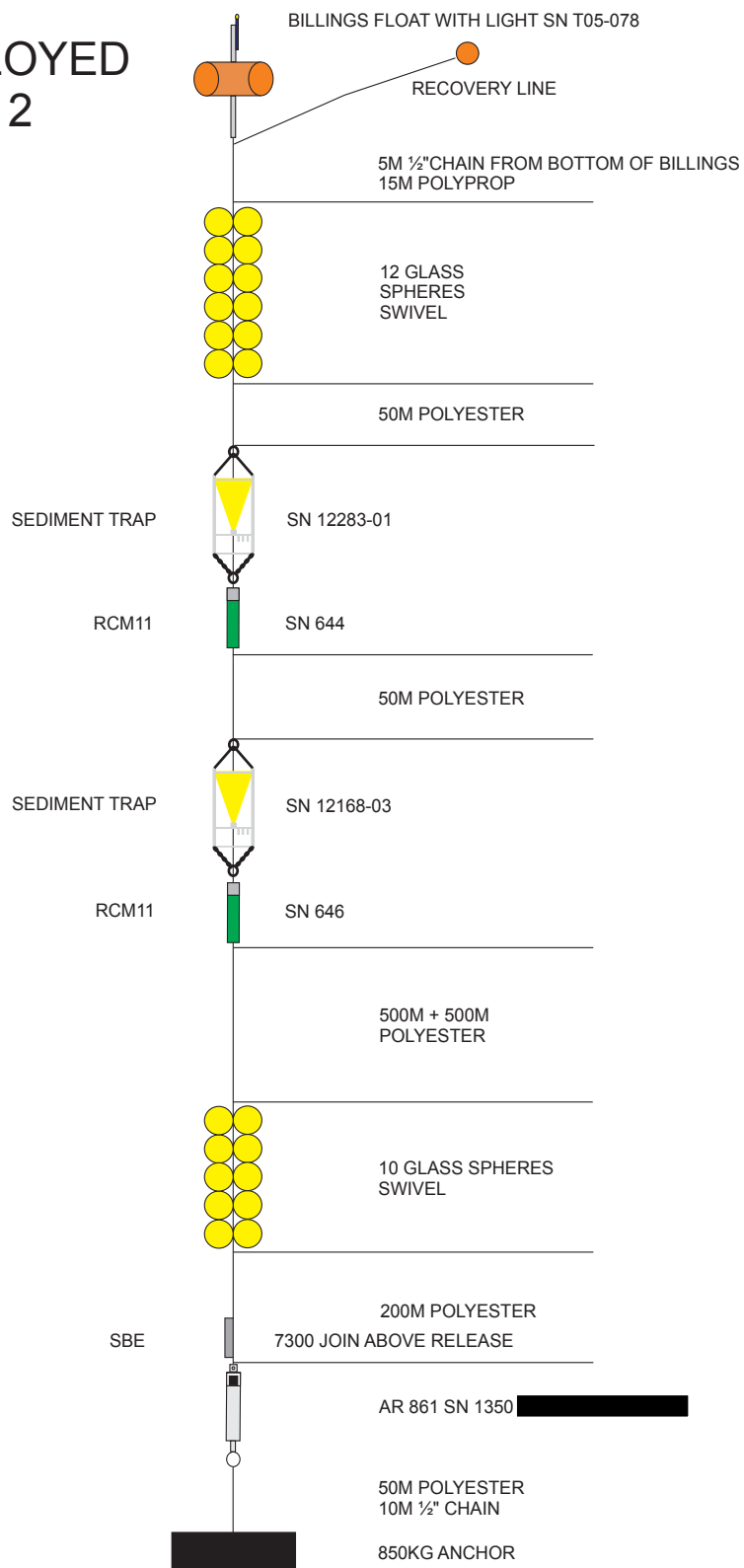
RAPID WATCH

MAR 3 AS DEPLOYED D328 2012

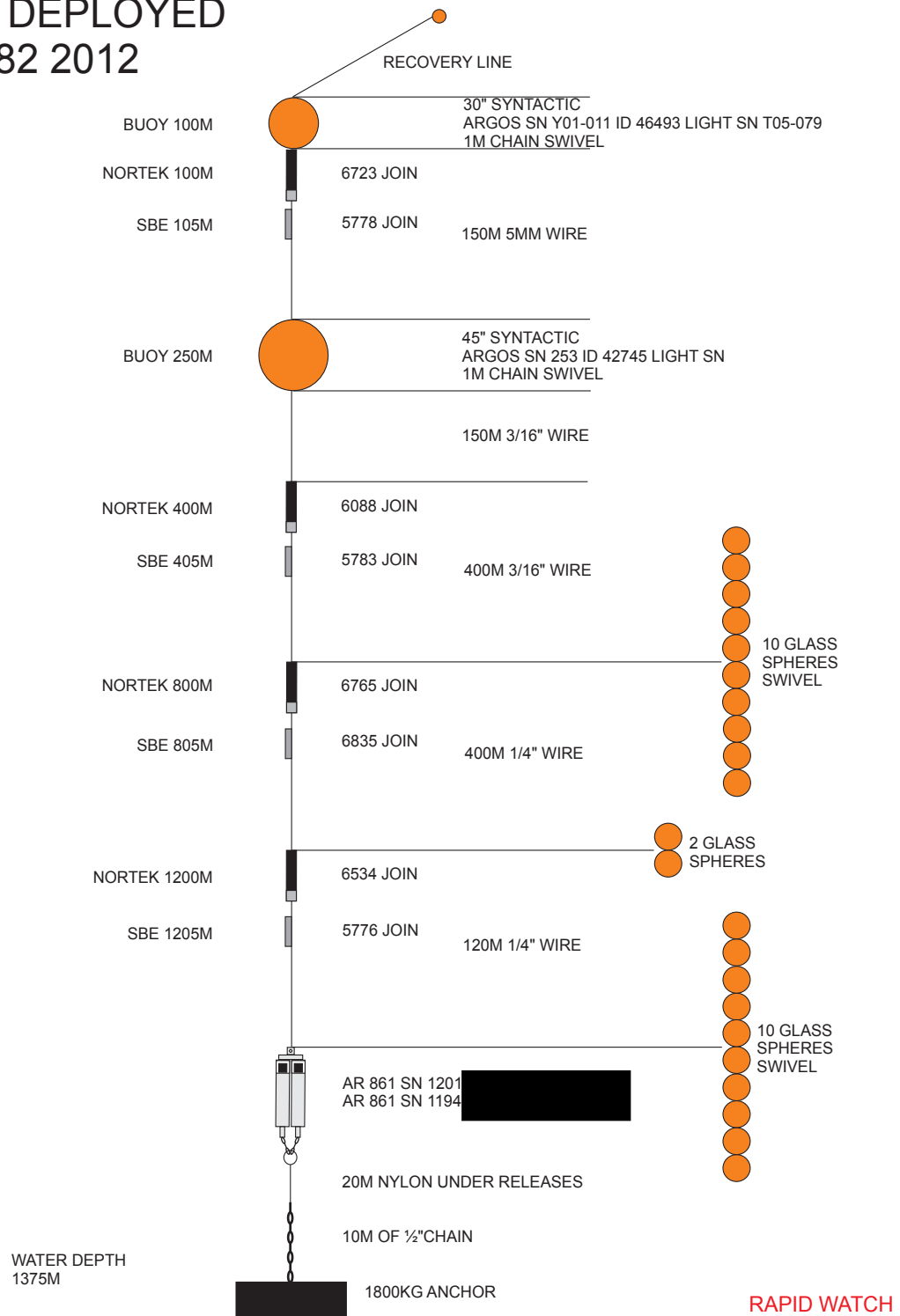


NOG AS DEPLOYED D382 2012

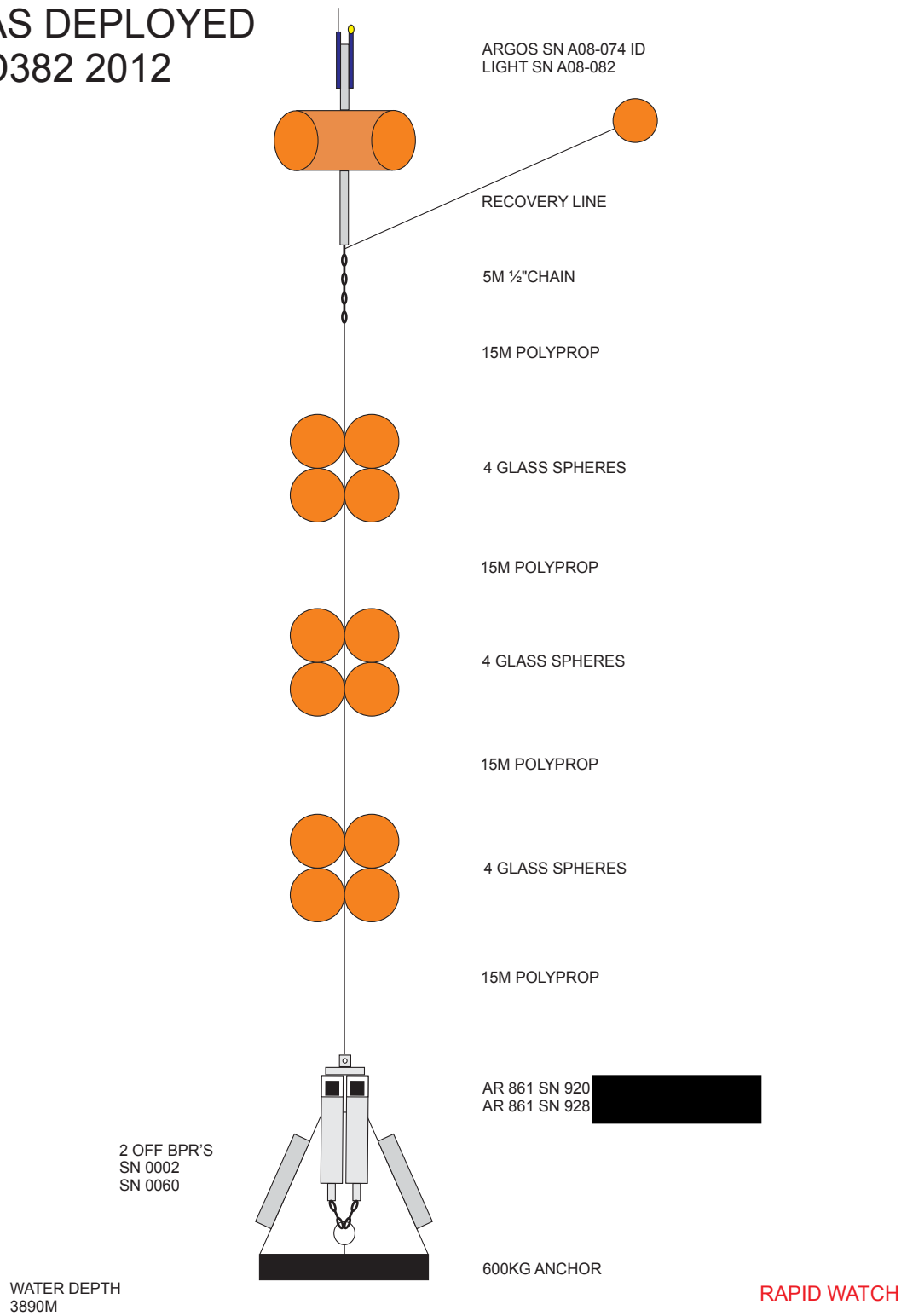
WATER DEPTH
4265M



WB 1 AS DEPLOYED D382 2012

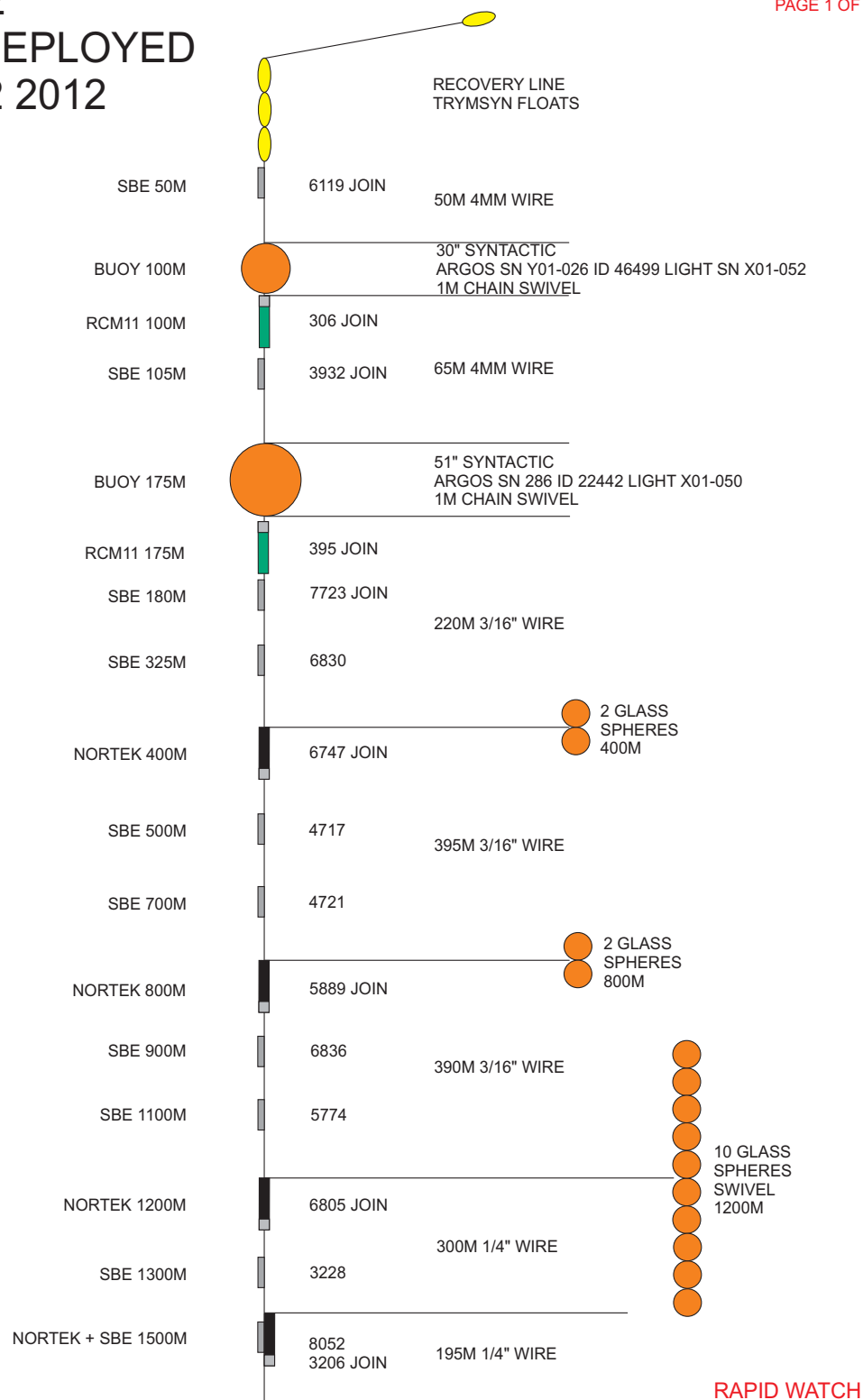


WB2L9
AS DEPLOYED
D382 2012



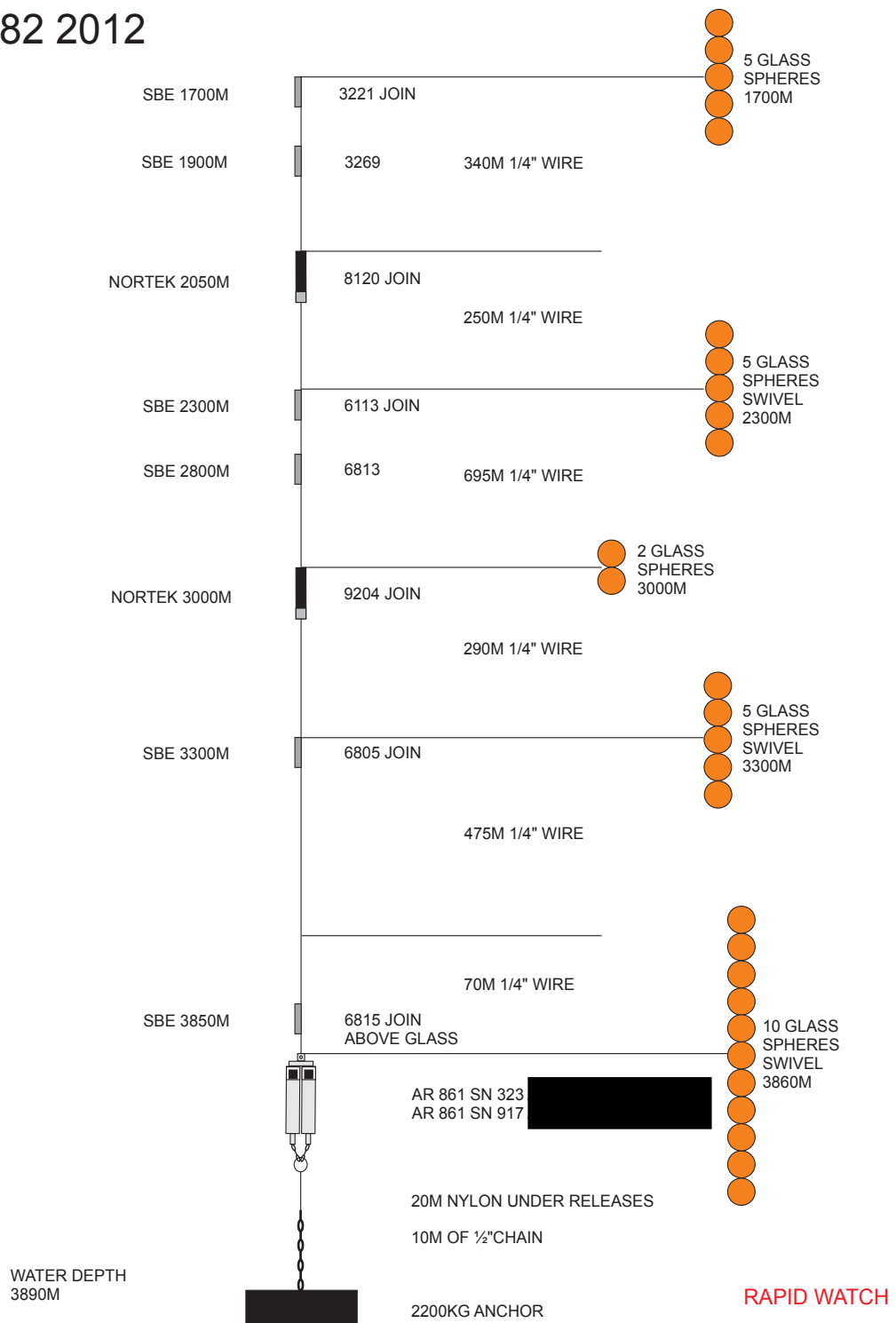
WB 2 AS DEPLOYED D382 2012

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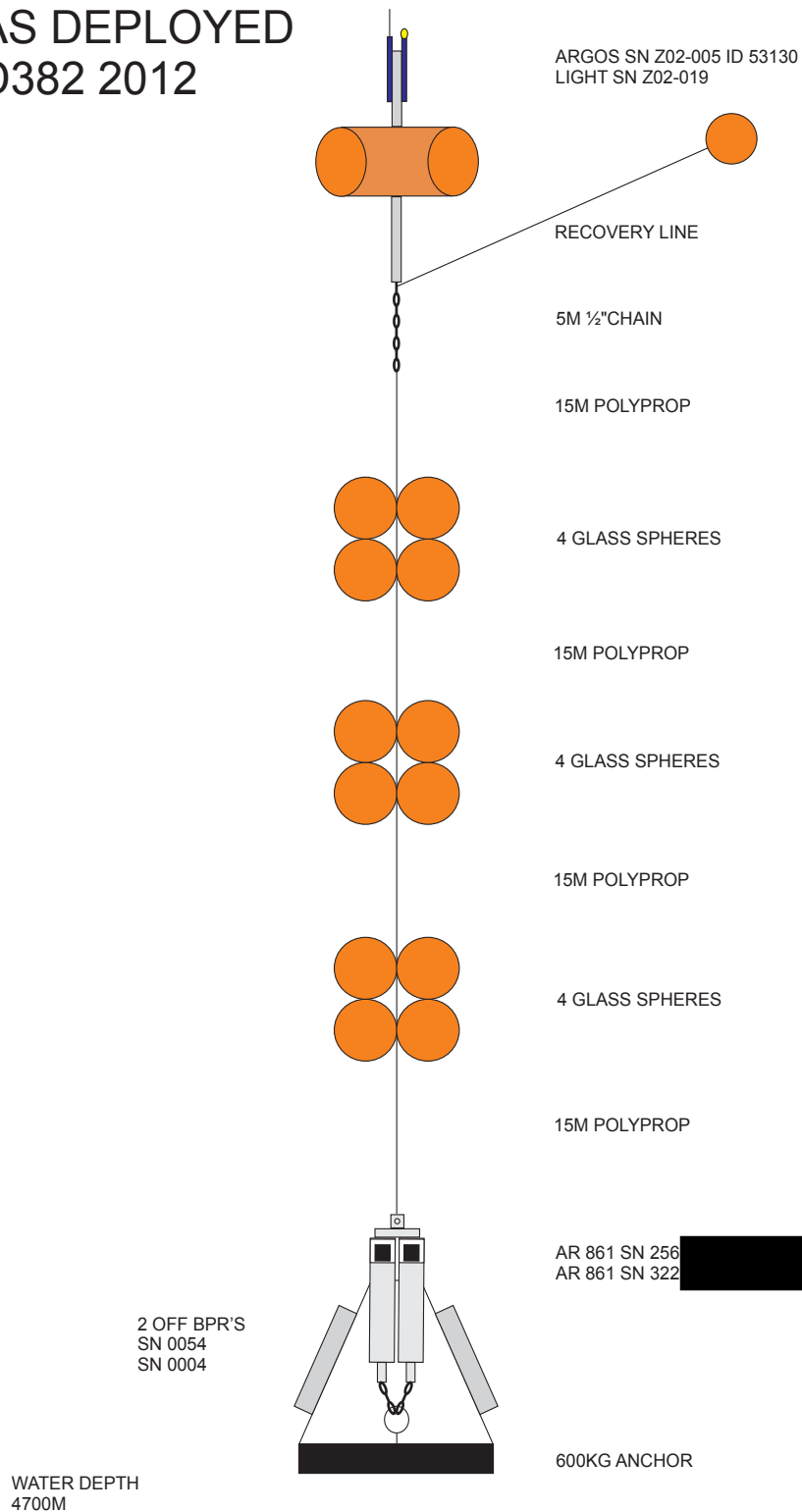


WB 2 AS DEPLOYED D382 2012

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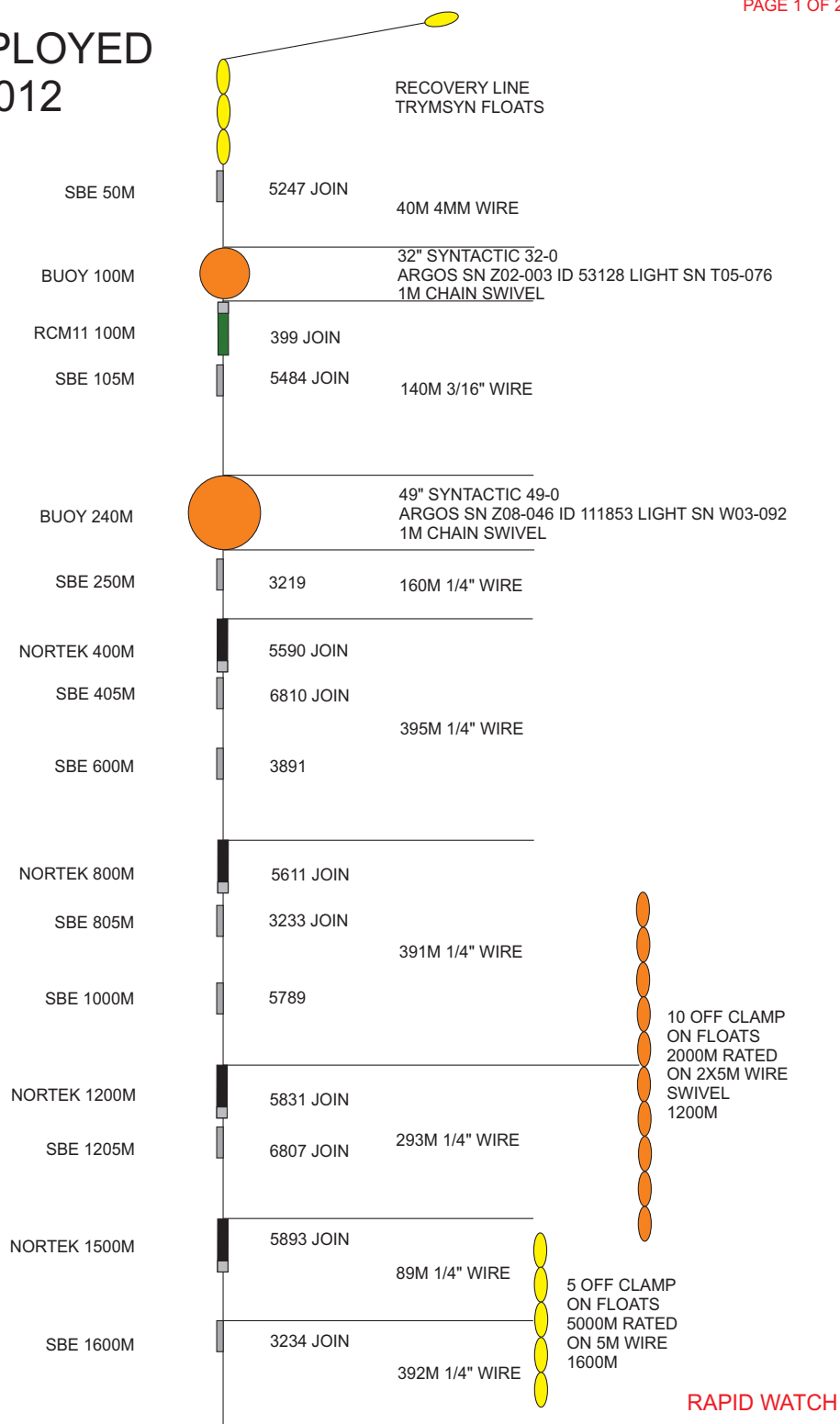
WB4L9 AS DEPLOYED D382 2012



RAPID WATCH

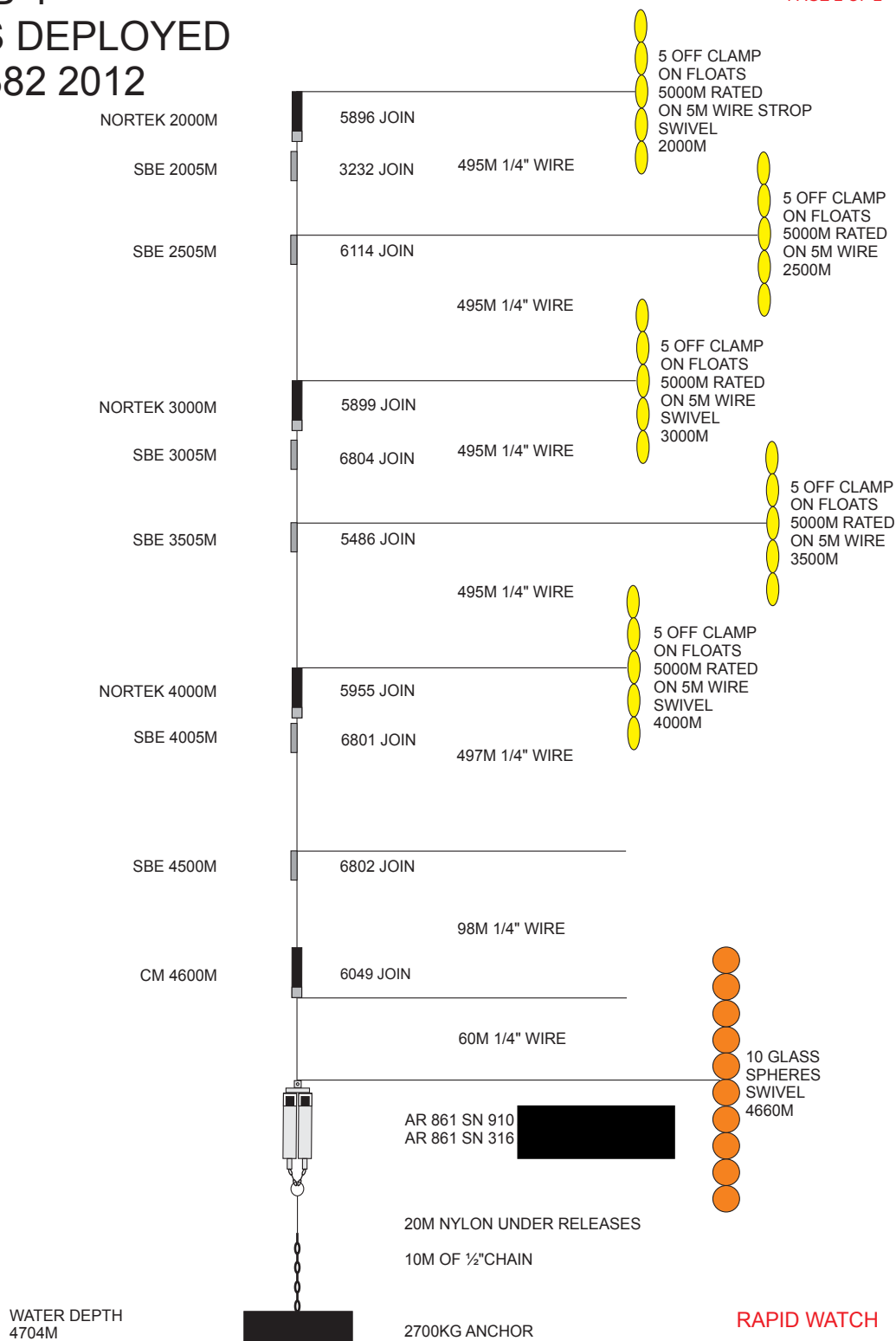
WB 4 AS DEPLOYED D382 2012

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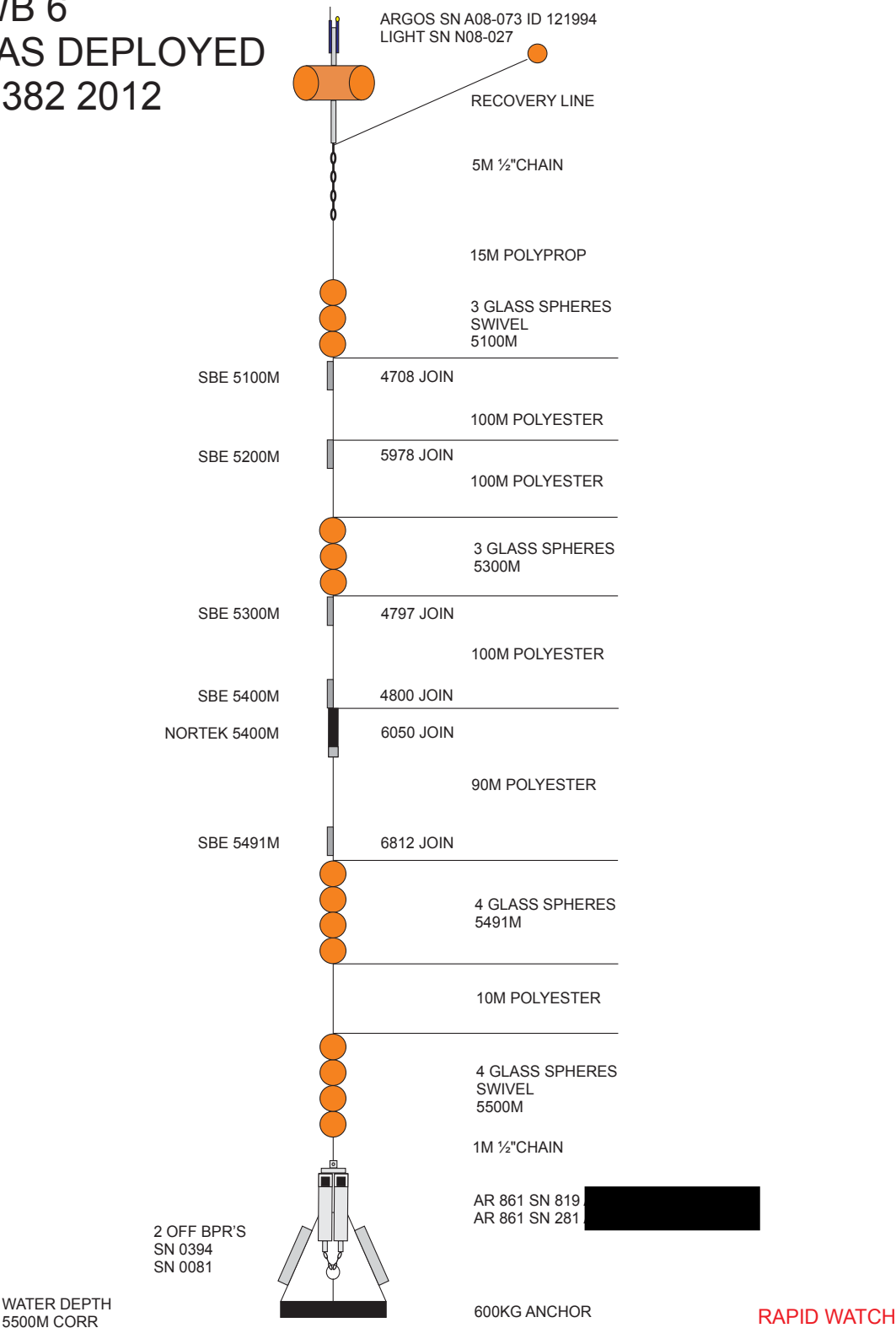


WB 4 AS DEPLOYED D382 2012

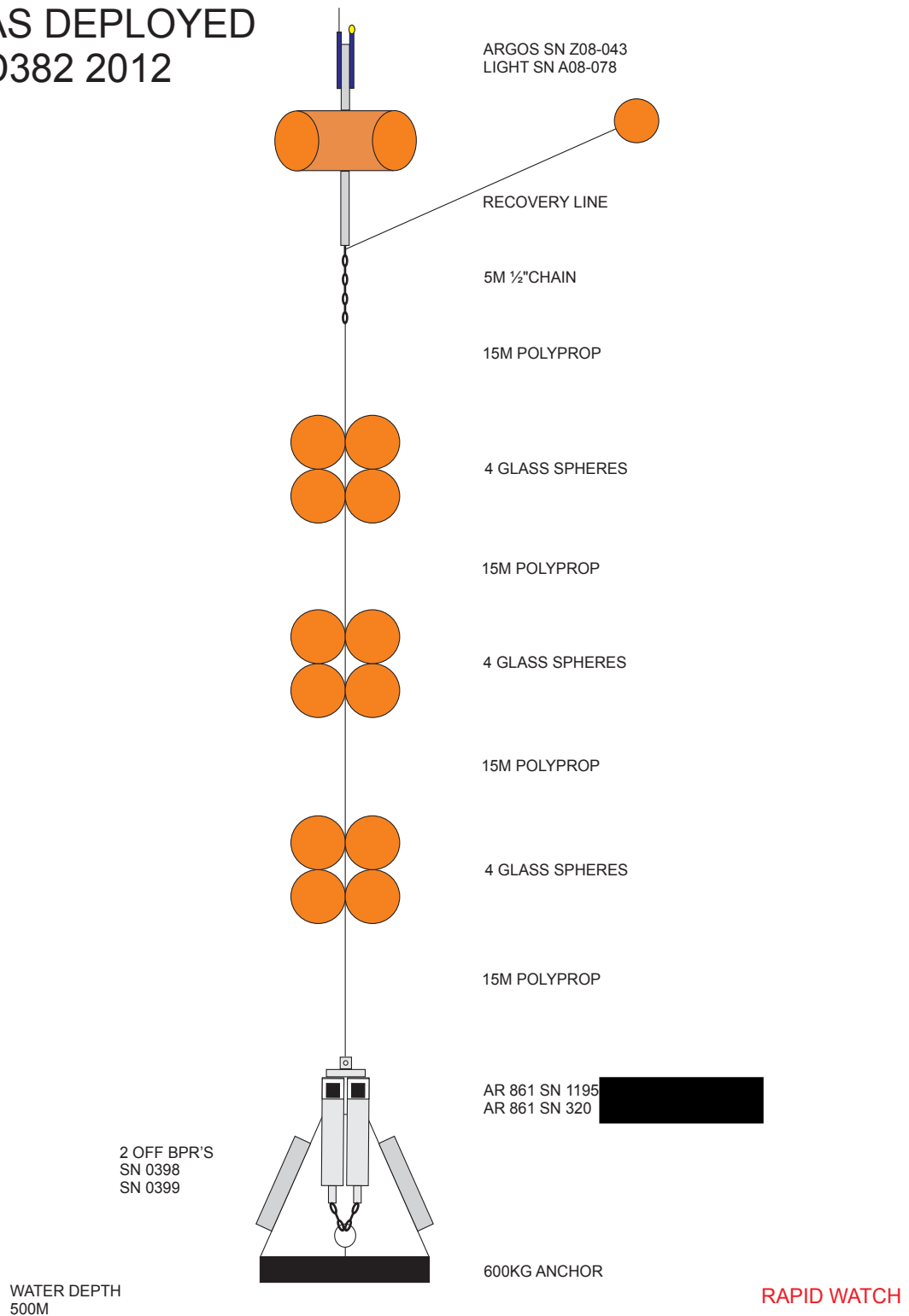
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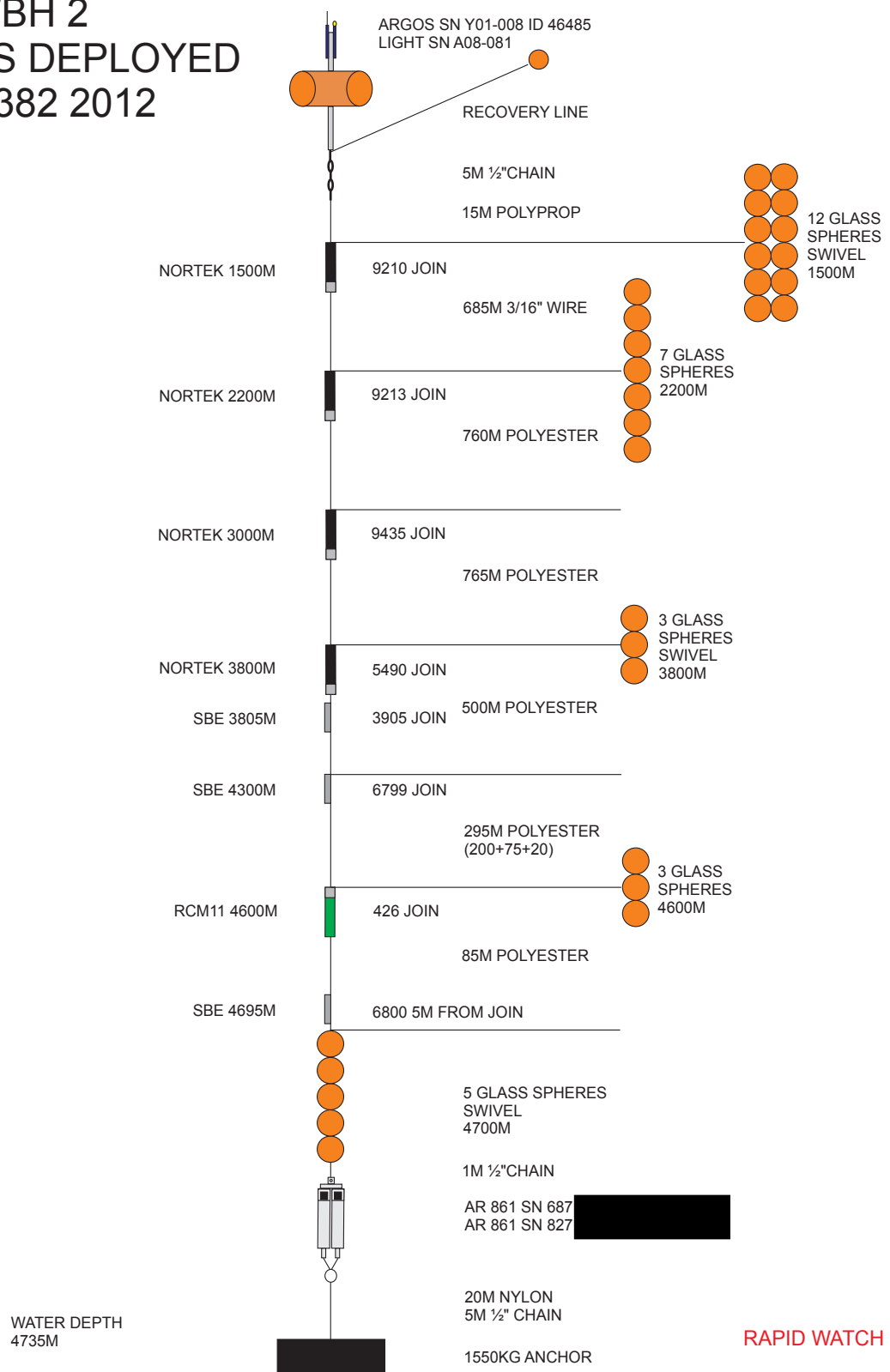
WB 6
TAS DEPLOYED
D382 2012



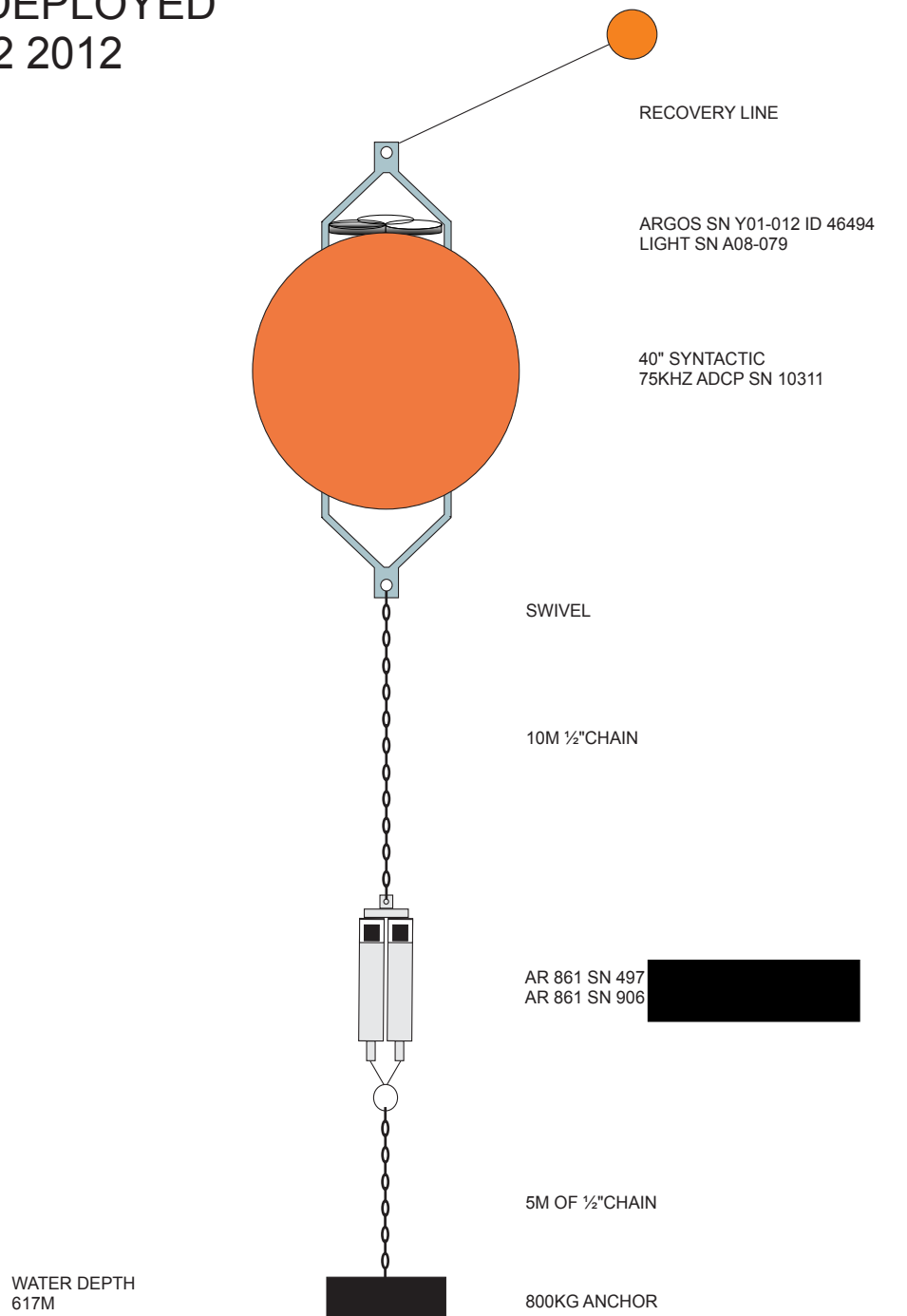
WBAL4 AS DEPLOYED D382 2012



WBH 2 AS DEPLOYED D382 2012



WB ADCP
AS DEPLOYED
D382 2012



RAPID WATCH

21 Mooring Recovery Logsheets

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EB1L7**

Cruise

D382

NB: all times recorded in GMT

Date 24/10/12

Site arrival time 07:05:46

Time of first ranging 07:06

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--------|-----------------------------|----------|
| Recovery line | n/a | surfaced approx 08:30-08:35 | 09:05:40 |
| Billings Float | n/a | billings imploded | |
| with Light | | | |
| and Argos Beacon | | | |
| 4 x 17" glass | n/a | orange | 09:01:59 |
| 4 x 17" glass | n/a | yellow | 09:05:20 |
| BPR | 0002 | 0054 | |
| BPR | 0061 | | |
| Acoustic Release #1 | 319 | | |
| Acoustic Release #2 | 924 | | 09:09:14 |

Ascent Rate 60 m min

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EB1**Cruise **D382****NB: all times recorded in GMT**Date 24/10/12Site arrival time 09:48:44Time of first ranging 09:50

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|---|---------------------|
| Recovery line | n/a | port side pick up, hooked 11:36:21 | 11:39:33 |
| 3 x Mini-Trimsyns | n/a | | |
| MicroCAT | 5486 <input checked="" type="checkbox"/> | banged and fouled | 11:39:46 |
| 24" syntactic float | n/a | wire parted, 2nd grapple needed | 12:34:27 |
| with Light | | second hook 12:27:56 | |
| and Argos Beacon | | | |
| Swivel | n/a | | |
| MicroCAT | 3891 <input checked="" type="checkbox"/> | | |
| 37" steel sphere | n/a | | 12:41:55 |
| with light | | | |
| and Argos Beacon | | | |
| Swivel | n/a | Hauling two wires | |
| MicroCAT | 5484 <input checked="" type="checkbox"/> | | |
| MicroCAT | 6804 <input checked="" type="checkbox"/> | | 12:50:43 |
| MicroCAT | 6805 <input checked="" type="checkbox"/> | | 12:56:48 |
| MicroCAT | 5789 <input checked="" type="checkbox"/> | | |
| 4 x 17" glass | n/a | | 12:59:43 |
| MicroCAT | 5247 <input checked="" type="checkbox"/> | Wire cut. Hauling two wires | 12:57:09 |
| 4 x 17" glass | n/a | | 12:59:48 |
| MicroCAT | 5245 <input checked="" type="checkbox"/> | | 13:11:55 |
| MicroCAT | 6113 <input checked="" type="checkbox"/> | | 13:15:33 |
| 4 x 17" glass | n/a | | 13:28:58 |
| Swivel | n/a | | |
| MicroCAT | 5244 <input checked="" type="checkbox"/> | Anode corroded | |
| Sontek | D273 <input checked="" type="checkbox"/> | annoid coroded | 13:49:07 |
| 4 x 17" glass | n/a | | |
| MicroCAT | 6814 <input checked="" type="checkbox"/> | Split wire | |
| MicroCAT | 3206 <input checked="" type="checkbox"/> | | |
| 4 x 17" glass | n/a | | 13:52:13 |
| Swivel | n/a | | |
| MicroCAT | 6114 <input checked="" type="checkbox"/> | | 14:18:29 |
| MicroCAT | 3266 <input checked="" type="checkbox"/> | | 14:26:13 |
| 4 x 17" glass | n/a | | 14:31:00 |
| Swivel | n/a | hange of drum hauling again at 14:47:22 | |
| MicroCAT | 6811 <input checked="" type="checkbox"/> | | 14:47:58 |

| | | | |
|---------------------|------|-------------------------------------|----------|
| 4 x 17" glass | n/a | | 14:53:53 |
| MicroCAT | 6815 | <input checked="" type="checkbox"/> | 14:58:13 |
| 4 x 17" glass | n/a | | 15:04:37 |
| Swivel | n/a | | |
| MicroCAT | 4549 | <input checked="" type="checkbox"/> | 15:05:37 |
| RCM11 | 303 | <input checked="" type="checkbox"/> | 15:22:55 |
| MicroCAT | 3225 | <input checked="" type="checkbox"/> | 15:23:30 |
| 8 x 17" glass | n/a | | 15:26:12 |
| Swivel | n/a | | |
| Acoustic Release #1 | 1203 | <input checked="" type="checkbox"/> | 15:27:19 |
| Acoustic Release #2 | 1197 | <input checked="" type="checkbox"/> | 15:27:22 |

Ascent Rate

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EBH1**
NB: all times recorded in GMT

Cruise **D382**

Date 15/10/12
 Time of first ranging 13:50

Site arrival time 13:50

| ITEM | SER NO | COMMENT | TIME |
|-----------------------------|--|--------------------------------|----------|
| Recovery line | n/a | surfaced 14:30 | 15:21:47 |
| Billings Float | n/a | slight tangle with pickup line | 15:28:35 |
| with Light | | | |
| and Argos Beacon | | | |
| 2 x 17" glass | n/a | | |
| Swivel | n/a | | 15:35 |
| MicroCAT | 3215 <input checked="" type="checkbox"/> | | 15:35 |
| 2 x 17" glass | n/a | | 15:42:17 |
| RCM11 | 301 <input checked="" type="checkbox"/> | | 15:47:58 |
| MicroCAT | 3244 <input checked="" type="checkbox"/> | | |
| 3 x 17" glass | n/a | four glass not three | 15:51 |
| Swivel | n/a | | |
| Acoustic Release #1 | 1200 <input checked="" type="checkbox"/> | | 15:51 |
| Acoustic Release #2 | 827 <input checked="" type="checkbox"/> | | 15:51 |

Ascent Rate 80m/min

Ranging

| Time | Range 1 | Range 2 | Command/comment |
|-------|---------|---------|----------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 13:50 | 3022 | | Arm + Arm |
| 13:52 | 3020 | 3020 | Arm + Release sn1200 |
| 13:53 | none | 2930 | |
| 13:54 | none | 2849 | eta 14:30 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

RECOVERY

Cruise **D382**

Site arrival time 16:15:21

Ascent Rate 80 m/min

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EBH2**
NB: all times recorded in GMT

Cruise **D382**

Date 16/10/12
 Time of first ranging 15.39

Site arrival time 1536

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|-----------------|----------|
| Recovery line | n/a | | 16:22:45 |
| Billings Float | n/a | | 16:24:21 |
| with Light | | | |
| and Argos Beacon | | no argos beacon | 16:26:50 |
| 2 x 17" glass | n/a | tangled | 16:27:21 |
| Swivel | n/a | | |
| MicroCAT | 3230 <input checked="" type="checkbox"/> | | 16:28:57 |
| 2 x 17" glass | n/a | | |
| MicroCAT | 3224 <input checked="" type="checkbox"/> | | |
| Sontek | D332 <input checked="" type="checkbox"/> | rusty anode | 16:38:44 |
| MicroCAT | 3265 <input checked="" type="checkbox"/> | | |
| 3 x 17" glass | n/a | | 16:41:06 |
| Swivel | n/a | | |
| Acoustic Release #1 | 1242 <input checked="" type="checkbox"/> | | 16:41:24 |
| Acoustic Release #2 | 927 <input checked="" type="checkbox"/> | | 16:41:27 |

Ascent Rate 65 m/min

3 cable setup

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EBH3**
NB: all times recorded in GMT

Cruise **D382**

Date 17/10/12
 Time of first ranging 07:46:21

Site arrival time overnight

| ITEM | SER NO | COMMENT | TIME |
|-----------------------------|--|------------------------|----------|
| Recovery line | n/a | surface 08:09 | 08:52:29 |
| Billings Float | n/a | | 08:56:49 |
| with Light | | | |
| and Argos Beacon | | no Argos | |
| 2 x Mini-Trimsyn | n/a | | 08:59:45 |
| MicroCAT | 3907 <input checked="" type="checkbox"/> | | |
| 2 x Mini Trimsyn | n/a | | 09:04:19 |
| MicroCAT | 6802 <input checked="" type="checkbox"/> | | |
| 2 x Mini Trimsyn | n/a | | 09:08:51 |
| MicroCAT | 6801 <input checked="" type="checkbox"/> | | 09:10:01 |
| 2 x Mini Trimsyn | n/a | | 09:13:11 |
| MicroCAT | 6800 <input checked="" type="checkbox"/> | | 09:14:32 |
| Sontek | D298 <input checked="" type="checkbox"/> | | 09:17:13 |
| MicroCAT | 6799 <input checked="" type="checkbox"/> | growth on cat and rope | 09:21:11 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 925 <input checked="" type="checkbox"/> | growth on releases | |
| Acoustic Release #2 | 908 <input checked="" type="checkbox"/> | | |

Ascent Rate 50 m/ min
 hooked 08:51

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EBH4**
NB: all times recorded in GMT

Cruise **D382**

Date 28/10/12
 Time of first ranging 08:34

Site arrival time 08:30

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|--|----------|
| Recovery line | n/a | spotted 08:42 | 09:11:55 |
| Billings Float | n/a | whole mooring on surface 08:50 | 09:18 |
| with Light | | | |
| and Argos Beacon | | | |
| 1 x 17" glass | n/a | | 09:19 |
| Swivel | n/a | | |
| MicroCAT | 3233 <input checked="" type="checkbox"/> | | 09:22:39 |
| MicroCAT | 3258 <input checked="" type="checkbox"/> | flooded. end cap missing | 09:24:59 |
| 2 x 17" glass | n/a | end cap recovered here. slid down wire | 09:27 |
| MicroCAT | 3254 <input checked="" type="checkbox"/> | | 09:29 |
| MicroCAT | 3219 <input checked="" type="checkbox"/> | | 09:31 |
| MicroCAT | 3221 <input checked="" type="checkbox"/> | | 09:33 |
| 2 x 17" glass | n/a | | 09:34 |
| MicroCAT | 3222 <input checked="" type="checkbox"/> | | 09:38:39 |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 264 <input checked="" type="checkbox"/> | | |
| Acoustic Release #2 | 906 <input checked="" type="checkbox"/> | | 09:44:09 |

Ascent Rate n/a

RECOVERY

Mooring **EBH4L2**
NB: all times recorded in GMT

Cruise **D382**

Date 28/10/12
Time of first ranging 06:42

Site arrival time 06:39:53

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--------|-------------------------------------|----------|
| Recovery line | n/a | surfaced 06:59 | 06:15:31 |
| Billings Float | n/a | fouling | 06:19:46 |
| with Light | | | |
| and Argos Beacon | | argos upside down | |
| 4 x 17" glass | n/a | surfaced before billings | 06:22:20 |
| 4 x 17" glass | n/a | | 06:25:49 |
| BPR | 0397 | 0002 | |
| BPR | 0054 | 0004 | |
| Acoustic Release #1 | 323 | <input checked="" type="checkbox"/> | |
| Acoustic Release #2 | 687 | <input checked="" type="checkbox"/> | 06:28:47 |

Ascent Rate 65 m min

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **EBH5**
NB: all times recorded in GMT

Cruise **D382**

Date 28/10/12
 Time of first ranging 10:14:23

Site arrival time 10:14:04

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|----------------------------------|----------|
| Recovery line | n/a | sighted 10:54, grappled 11:22:49 | 11:22 |
| Billings Float | n/a | fouling | 11:25:24 |
| with Light | | | |
| and Argos Beacon | | | |
| MicroCAT | 3223 <input checked="" type="checkbox"/> | | 11:32:25 |
| 2 x 17" glass | n/a | | 11:34:41 |
| Swivel | n/a | | |
| MicroCAT | 3228 <input checked="" type="checkbox"/> | | 11:35:50 |
| MicroCAT | 3269 <input checked="" type="checkbox"/> | | 11:38:23 |
| 2 x 17" glass | n/a | | 11:42:38 |
| RCM11 | 305 <input checked="" type="checkbox"/> | | 11:44:02 |
| 2 x 17" glass | n/a | | 11:49:41 |
| Sontek | D278 | tick | 11:52:39 |
| Sontek | D322 <input checked="" type="checkbox"/> | | 11:56:05 |
| 5 x 17" glass | n/a | | 11:59:34 |
| Swivel | n/a | | " |
| Acoustic Release #1 | 249 <input type="checkbox"/> | | " |
| Acoustic Release #2 | 256 <input type="checkbox"/> | | " |

Ascent Rate n/a

RECOVERY

Cruise **D382**Site arrival time overnight

| | |
|--------------------|-----------------|
| Ascent Rate | <u>80 m min</u> |
|--------------------|-----------------|

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **MAR0**
NB: all times recorded in GMT

Cruise **D382**

Date 10/11/12
 Time of first ranging 08:20

Site arrival time 08:20

| ITEM | SER NO | COMMENT | TIME |
|---------------------|-----------------------------------|-------------------------------------|------|
| Recovery line | n/a | | |
| Billings Float | n/a | LOST | |
| with Light | Y01-017 <input type="checkbox"/> | Communications intermittent | |
| and Argos Beacon | X02-055 <input type="checkbox"/> | Tried firing from three different | |
| 2 x 17" glass | n/a | locations | |
| Swivel | n/a | Both releases returned 'release ok' | |
| MicroCAT | 5764 <input type="checkbox"/> | on a number of occasions | |
| MicroCAT | 5771 <input type="checkbox"/> | However the mooring didn't leave | |
| 2 x 17" glass | n/a | the seabed | |
| Swivel | n/a | Suspected implosion | |
| MicroCAT | 4715 <input type="checkbox"/> | | |
| S4 | 35612578 <input type="checkbox"/> | | |
| MicroCAT | 4711 <input type="checkbox"/> | | |
| MicroCAT | 4709 <input type="checkbox"/> | | |
| 8 x 17" glass | n/a | | |
| BPR | 0032 <input type="checkbox"/> | | |
| BPR | 0418 <input type="checkbox"/> | | |
| Acoustic Release #1 | 826 <input type="checkbox"/> | | |
| Acoustic Release #2 | 1199 <input type="checkbox"/> | | |

Ascent Rate _____

Ranging

| Time | Range 1 | Range 2 | Command/comment |
|----------|---------|---------|-------------------|
| 08:15:44 | - | - | Arm + Arm |
| 08:16:40 | - | 5507 | |
| 08:17:38 | - | - | Arm + Arm |
| 08:18:19 | - | - | Arm + Arm |
| 08:19:13 | - | - | |
| 08:20:25 | - | 12437 | Arm + Arm |
| 08:21:11 | - | - | |
| 08:21:55 | 5515 | - | |
| 08:23:23 | 5515 | - | Arm + Release,m |
| 08:24:10 | - | 5516 | no answer |
| 08:25:17 | - | 5164 | |
| 08:26:01 | - | 5517 | release ok |
| 08:27:02 | - | - | |
| 08:27:41 | 3641 | - | |
| 08:28:40 | - | - | |
| 08:29:23 | - | 5514 | no answer |
| 08:30:04 | - | - | |
| 08:32:59 | 5480 | - | transducer deeper |
| 08:33:33 | 5480 | 13070 | |
| 08:34:20 | 5480 | 5480 | |
| | 4849 | 13070 | - |
| 08:36:32 | 5477 | | - |
| 08:37:27 | 5479 | 5479 | release ok |
| 08:37:59 | 5477 | 13587 | - |
| 08:38:53 | - | 5477 | - |
| 08:39:58 | - | - | |
| 08:41:48 | 5476 | 5475 | ok |
| 08:42:19 | 5477 | - | - |
| 08:42:46 | 5477 | 5478 | - |
| 08:43:34 | 5478 | 4683 | - |
| 08:44:11 | - | 13055 | - |
| 08:45:11 | 5477 | 13075 | - |
| 08:46:35 | | | ok |
| 08:46:48 | 5476 | 5474 | ok |
| 08:47:23 | 5474 | 12994 | - |
| | | | |

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **MAR1L6**
NB: all times recorded in GMT

Cruise **D382**

Date 08/11/12
 Time of first ranging 09:33

Site arrival time overnight

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|-----------------------------------|------|
| Recovery line | n/a | | |
| Billings Float | n/a | NOT RECOVERED | |
| with Light | Y01-022 | Communications good | |
| and Argos Beacon | X02-054 | Releases OK | |
| 4 x 17" glass | n/a | Likely implosion of glass | |
| 4 x 17" glass | n/a | Retried in evening: same response | |
| BPR | 0028 | | |
| BPR | 0063 | | |
| Acoustic Release #1 | 163 | | |
| Acoustic Release #2 | 1196 | | |

Ascent Rate _____

Ranging

| Time | Range 1 | Range 2 | Command/comment |
|----------|---------|---------|---------------------------------------|
| 09:33:19 | 9753 | 6426 | Arm + Arm |
| 09:33:45 | 1480 | 7546 | Arm + Arm |
| 09:39:13 | 3427 | | release ok |
| 09:40:11 | 6439 | | no answer |
| 09:41:11 | 5481 | 6439 | release ok |
| 09:42:09 | 6440 | | |
| 09:43:58 | 6437 | 6388 | release ok |
| 09:44:44 | 6428 | 6427 | release ok |
| 09:45:56 | 8685 | 6754 | |
| 09:46:46 | 5162 | 1459 | |
| | 6395 | 6393 | |
| 09:48:22 | 4646 | | |
| 10:17:08 | 5217 | 5217 | Arm + Arm not fired |
| 10:18:15 | 5218 | 5215 | Arm + Release |
| 10:19:07 | 5114 | 5215 | |
| 10:20:04 | 5217 | 5216 | |
| 10:21:15 | - | 5216 | release ok. second release |
| 10:22:06 | 5216 | 5216 | vertical, good battery, not releasing |
| | | | |

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **MAR1**
NB: all times recorded in GMT

Cruise **D382**

Date 08/11/12
 Time of first ranging 11:04

Site arrival time 11:00

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---|--|----------|
| Recovery line | n/a | spotted by bridge shortly after firing | |
| 3 x Mini-Trimsyn | n/a | | 12:54:14 |
| MicroCAT | 6835 <input checked="" type="checkbox"/> | 6335, not 6835 | 12:56:00 |
| 24" syntactic float | n/a | | |
| with Light | T05-079 <input type="checkbox"/> | | |
| and Argos Beacon | Y01-008 <input type="checkbox"/> | | |
| MicroCAT | 6321 <input checked="" type="checkbox"/> | | 13:00:40 |
| 37" Steel Sphere | n/a | | |
| with Light | W03-094 <input checked="" type="checkbox"/> | | 13:03:00 |
| and Argos Beacon | 304 <input checked="" type="checkbox"/> | | |
| Swivel | n/a | | |
| MicroCAT | 6324 <input checked="" type="checkbox"/> | | 13:08:40 |
| MicroCAT | 4721 <input checked="" type="checkbox"/> | | 13:09:49 |
| MicroCAT | 5485 <input checked="" type="checkbox"/> | | 13:15:35 |
| MicroCAT | 6806 <input checked="" type="checkbox"/> | ge tangle after microcat, cut and reattach | 13:17:21 |
| MicroCAT | 6807 <input checked="" type="checkbox"/> | | 13:26:03 |
| 8 x 17" glass | n/a | | 13:29:25 |
| Swivel | n/a | | |
| MicroCAT | 4717 <input checked="" type="checkbox"/> | | 13:29:46 |
| MicroCAT | 6809 <input checked="" type="checkbox"/> | | 13:36:35 |
| MicroCAT | 4708 <input checked="" type="checkbox"/> | | 13:40:12 |
| Sontek | D295 <input checked="" type="checkbox"/> | | 13:46:46 |
| MicroCAT | 5784 <input checked="" type="checkbox"/> | | 13:48:03 |
| 8 x 17" glass | n/a | | 13:56:01 |
| Swivel | n/a | | |
| MicroCAT | 6812 <input checked="" type="checkbox"/> | | 13:58:36 |
| 4 x 17" glass | n/a | | 14:06:48 |
| Swivel | n/a | | |
| MicroCAT | 3932 <input checked="" type="checkbox"/> | | 14:07:53 |
| 4 x 17" glass | n/a | tangled | 14:18:35 |
| Swivel | n/a | | |
| MicroCAT | 6813 <input checked="" type="checkbox"/> | | 14:18:43 |
| 4 x 17" glass | n/a | | 15:21:03 |
| Swivel | n/a | | |
| MicroCAT | 3919 <input checked="" type="checkbox"/> | | 15:31:28 |
| 4 x 17" glass | n/a | | |

| | |
|--------------------|------------|
| Ascent Rate | <u>n/a</u> |
|--------------------|------------|

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **MAR2**
NB: all times recorded in GMT

Cruise **D382**

Date 07/11/12
 Time of first ranging 17:46:27

Site arrival time 17:45

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|--------------------------------|----------|
| Recovery line | n/a | surfaced 1809, hooked 19:29:31 | 19:33:58 |
| Billings float | n/a | | |
| with Light | <input checked="" type="checkbox"/> | | |
| and Argos Beacon | <input checked="" type="checkbox"/> | | |
| 4 x 17" glass | n/a | | 19:30:46 |
| Swivel | n/a | | |
| MicroCAT | 3931 <input checked="" type="checkbox"/> | | |
| MicroCAT | 3911 <input checked="" type="checkbox"/> | | 19:45:39 |
| MicroCAT | 6115 <input checked="" type="checkbox"/> | | 19:50:12 |
| 4 x 17" glass | n/a | | 19:54:12 |
| Swivel | n/a | | |
| MicroCAT | 6116 <input checked="" type="checkbox"/> | | 19:56:06 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 6117 <input checked="" type="checkbox"/> | | 20:05:00 |
| 3 x 17" glass | n/a | | 20:13:48 |
| Swivel | n/a | | |
| MicroCAT | 3928 <input checked="" type="checkbox"/> | | 20:21:36 |
| MicroCAT | 5243 <input checked="" type="checkbox"/> | | 20:29:26 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 5239 <input checked="" type="checkbox"/> | | 20:40 |
| 3 x 17" glass | n/a | 21:20:20 last thing on deck | |
| Swivel | n/a | | |
| MicroCAT | 5778 <input checked="" type="checkbox"/> | 21:19:45 | |
| MicroCAT | 6119 <input checked="" type="checkbox"/> | tangled | 20:36 |
| 4 x 17" glass | n/a | | |
| S4 | 35612571 <input checked="" type="checkbox"/> | | 21:09:41 |
| MicroCAT | 6120 <input checked="" type="checkbox"/> | | |
| 5 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | | | 21:06:47 |
| Acoustic Release #2 | | | |

Ascent Rate 60 m min major tangling for second year running

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **MAR3**
NB: all times recorded in GMT

Cruise **D382**

Date 05/11/12
 Time of first ranging 09:38

Site arrival time 09:38

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|--------------------------|----------|
| Recovery line | n/a | spotted 10:25 | 12:13:12 |
| Billings float | n/a | | 12:17:29 |
| with Light | | | |
| and Argos Beacon | | | |
| 2 x 17" glass | n/a | | 12:18:31 |
| Swivel | n/a | | |
| MicroCAT | 5776 <input checked="" type="checkbox"/> | | 12:17:35 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 5774 <input checked="" type="checkbox"/> | | 12:34:00 |
| 3 x 17" glass | n/a | | 12:45:50 |
| Swivel | n/a | | |
| MicroCAT | 6835 <input checked="" type="checkbox"/> | | 12:46:54 |
| 3 x 17" glass | n/a | | 12:57:22 |
| Swivel | n/a | | 12:57:19 |
| MicroCAT | 6810 <input checked="" type="checkbox"/> | | 12:57:15 |
| 3 x 17" glass | n/a | | 13:04:55 |
| Swivel | n/a | | 13:04:55 |
| MicroCAT | 6836 <input checked="" type="checkbox"/> | | 13:06:40 |
| MicroCAT | 5770 <input checked="" type="checkbox"/> | | 13:14:39 |
| 8 x 17" glass | n/a | 4 spheres imploded, 4 ok | 13:16:20 |
| Swivel | n/a | | |
| S4 | 35612568 <input checked="" type="checkbox"/> | | 13:17:58 |
| Acoustic Release #1 | 917 <input checked="" type="checkbox"/> | | 13:21:11 |
| Acoustic Release #2 | 322 <input checked="" type="checkbox"/> | | 13:21:14 |

Ascent Rate 60 m min

grapple slipped on first pass
 had to go round again
 bottom two packs not on surface
 suspected implosion

RECOVERY

Cruise **D382**

Site arrival time 07:00

Ascent Rate 80 m min

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **NOG**
NB: all times recorded in GMT

Cruise **D382**

Date 05/11/12
 Time of first ranging 17:21

Site arrival time 17:21

| ITEM | SER NO | COMMENT | TIME |
|---------------------|--|-------------------|----------|
| Recovery line | n/a | grappled 18:43:05 | |
| Billings Float | n/a | | 18:50:02 |
| with Light | T05-078 <input checked="" type="checkbox"/> | | |
| 12 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Sediment Trap | 12168-02 <input checked="" type="checkbox"/> | | 19:00:38 |
| Nortek | 8100 <input checked="" type="checkbox"/> | | 19:04:18 |
| Sediment Trap | 12168-04 <input checked="" type="checkbox"/> | | 19:08:25 |
| Nortek | 8092 <input checked="" type="checkbox"/> | | 19:11:49 |
| 10 x 17" glass | n/a | | 19:32:35 |
| Acoustic Release #1 | 822 <input checked="" type="checkbox"/> | | 19:37:23 |

Ascent Rate 60 m min

mooring came up much faster than
 anticipated
 surfaced at 18:15

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **WB1**Cruise **D382****NB: all times recorded in GMT****Date** 17/11/12**Site arrival time** 1300**Time of first ranging** 1303

| ITEM | SER NO | COMMENT | TIME |
|---------------------------|--|-----------------------------|----------|
| 1 x Trimsyn pick up float | | | 14:28:13 |
| 3 Trymsyn floats | | | 14:27:59 |
| SBE37 MicoCAT | 6123 <input checked="" type="checkbox"/> | heavy fouling | 14:28:02 |
| 30" SYNTACTIC | | | 14:24:32 |
| ARGOS | | | |
| Light | | | |
| swivel | | | |
| Nortek | 9409 <input checked="" type="checkbox"/> | | 14:24:26 |
| SBE37 MicoCAT | 6121 <input checked="" type="checkbox"/> | | 14:24:23 |
| SBE37 MicoCAT | 4072 <input checked="" type="checkbox"/> | | 14:20:12 |
| 45" syntactic | | hooked 14:03:09 | 14:10:28 |
| ARGOS | | | |
| LIGHT | | | |
| swivel | | | |
| SBE37 MicoCAT | 6820 <input checked="" type="checkbox"/> | | 14:31:35 |
| SBE37 MicoCAT | 4180 <input checked="" type="checkbox"/> | no guard | 14:32:28 |
| Nortek | 5890 <input checked="" type="checkbox"/> | | 14:35:01 |
| SBE37 MicoCAT | 5773 <input checked="" type="checkbox"/> | | |
| SBE37 MicoCAT | 3248 <input checked="" type="checkbox"/> | | 14:39:50 |
| SBE37 MicoCAT | 3902 <input checked="" type="checkbox"/> | no guard | 14:42:21 |
| SBE37 MicoCAT | 4472 <input checked="" type="checkbox"/> | | 14:45:25 |
| 10 x 17" glass spheres | | | 14:51:20 |
| SWIVEL | | | |
| Nortek | 5897 <input checked="" type="checkbox"/> | | |
| SBE37 MicoCAT | 5768 <input checked="" type="checkbox"/> | | 15:01:15 |
| SBE37 MicoCAT | 5782 <input checked="" type="checkbox"/> | | 15:03:59 |
| SBE37 MicoCAT | 4471 <input checked="" type="checkbox"/> | 15:08 after 4068 on mooring | 15:06:31 |
| SBE37 MicoCAT | 4068 <input checked="" type="checkbox"/> | 1506 before 4471 on mooring | |
| 2 x 17" glass | | | 15:11:51 |
| Nortek | 5889 <input checked="" type="checkbox"/> | 15:11 | |
| SBE37 MicoCAT | 7468 <input checked="" type="checkbox"/> | | 15:14:08 |
| SBE37 MicoCAT | 7363 <input checked="" type="checkbox"/> | | 15:17:13 |
| 10 x 17" glass | | | |
| SWIVEL | | | |
| Acoustic release #1 | 823 <input checked="" type="checkbox"/> | | 15:17:34 |
| Acoustic release #2 | 1461 <input checked="" type="checkbox"/> | | |

| | |
|-------------------------|--------------|
| Ascent Rate | n/a |
| Time at end of recovery | <u>15:17</u> |

Ranging

[illegible]

RECOVERY

Mooring **WB2L7**Cruise **D382**

NB: all times recorded in GMT

Date 20/11/12

Site arrival time 20:30

Time of first ranging 20:33

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--|-----------------------------|----------|
| 1 x Trymsyn pickup float | | surf. 2123. hooked 21:47:04 | 22:14:50 |
| Billings float | | | 22:04:53 |
| ARGOS | | | |
| LIGHT | | | |
| 4 x 17" glass | | | 21:59:37 |
| 4 x 17" glass | | | 21:54:48 |
| 4 x 17" glass | | | |
| BPR #1 in tripod | 0055 <input checked="" type="checkbox"/> | | |
| BPR #2 in tripod | 0056 <input checked="" type="checkbox"/> | | |
| Release #1 in tripod | | 916 | |
| Release #2 in tripod | | 918 | 22:19:50 |

| | |
|--------------------------------|-----------------|
| Ascent Rate | 85 m min |
| Time at end of recovery | <u>22:19:55</u> |

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **WB2**Cruise **D382****NB: all times recorded in GMT****Date** 20/11/12**Site arrival time** overnight**Time of first ranging** 11:06

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--|--------------------------------------|----------|
| 1 x Trymsyn pickup float | | spotted some way off. both lights on | 12:31 |
| 3 x Trymsyn floats | | | 12:40:35 |
| SBE 37 MicroCAT | 5781 <input checked="" type="checkbox"/> | | 12:40 |
| 30" SYNTACTIC | | | |
| ARGOS | | sn y01-026 id 46499 | |
| Light | | sn x01-052 | |
| swivel | | | |
| RCM11 | 448 <input checked="" type="checkbox"/> | | 12:47 |
| SBE 37 MicroCAT | 5780 <input checked="" type="checkbox"/> | | 12:49:54 |
| 51" syntactic | | | 12:52:36 |
| ARGOS | | sn 286 id 22442 | |
| Light | | x01-050 | |
| swivel | | | |
| RCM11 | 449 <input checked="" type="checkbox"/> | | 12:52:45 |
| SBE 37 MicroCAT | 6821 <input checked="" type="checkbox"/> | | 12:52:48 |
| SBE 37 MicroCAT | 6822 <input checked="" type="checkbox"/> | | 13:04:09 |
| 2 x 17" glass | | | |
| Nortek | 6753 <input checked="" type="checkbox"/> | | 13:06:17 |
| SBE37 MicroCAT | 3933 <input checked="" type="checkbox"/> | | 13:09:06 |
| SBE 37 MicroCAT | 5763 <input checked="" type="checkbox"/> | | 13:11:08 |
| SBE 37 MicroCAT | 4307 <input checked="" type="checkbox"/> | | 13:15:49 |
| 2 x 17" glass | | | 13:18:26 |
| Nortek | 6119 <input checked="" type="checkbox"/> | | 13:18:23 |
| SBE 37 MicroCAT | 4470 <input checked="" type="checkbox"/> | | 13:23:12 |
| SBE 37 MicroCAT | 5762 <input checked="" type="checkbox"/> | | 13:26:30 |
| 10 x 17" glass | | | 13:29:22 |
| Swivel | | | |
| Nortek | 5884 <input checked="" type="checkbox"/> | | 13:31:28 |
| SBE 37 MicroCAT | 3209 <input checked="" type="checkbox"/> | | 13:34:45 |
| Nortek | 6176 <input checked="" type="checkbox"/> | | 13:38:46 |
| MicroCAT | 6333 <input checked="" type="checkbox"/> | | 13:38:43 |
| 5 x 17" glass | | | 13:44:06 |
| SBE 37 MicroCAT | 5785 <input checked="" type="checkbox"/> | | 13:44:03 |
| SBE 37 MicroCAT | 3934 <input checked="" type="checkbox"/> | | 13:49:40 |
| Nortek | 5967 <input checked="" type="checkbox"/> | | 13:54:00 |

| | | | |
|------------------------|------|--|----------|
| 5 x 17" glass | | | 13:59:33 |
| Swivel | | | |
| SBE 37 MicroCAT | 4475 | | 14:00:19 |
| SBE 37 MicroCAT | 4719 | | 14:11:12 |
| 2 x 17" glass spheres | | | |
| Nortek | 9266 | | 14:15:26 |
| 5 x 17" glass spheres | | | 14:23:43 |
| swivel | | | |
| SBE 37 MicroCAT | 3483 | slipped down wire | 14:30:37 |
| SBE 37 MicroCAT | 6828 | correct place - 14:36 | |
| 10 x 17" glass spheres | | | 14:36 |
| Swivel | | | |
| Release #1 | 324 | | 14:36:04 |
| Release #2 | 1406 | damaged-top ring gone. this is the one that re | |

Ascent Rate n/a
Time at end of recovery 14:36

Ranging

[illegible]

RECOVERY

Mooring **WB4L7**Cruise **D382**

NB: all times recorded in GMT

Date 18/11/12
Time of first ranging 10:30:32

Site arrival time overnight

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--------|-------------------------------------|----------|
| 1 x Trymsyn pickup float | | surfaced 11:27:23, hooked 11:47:19 | 11:52:17 |
| Billings float | | | |
| ARGOS | | | |
| LIGHT | | | |
| 4 x 17" glass | | large tangle, came up in one clump | 12:08:11 |
| 4 x 17" glass | | | 11:52:24 |
| 4 x 17" glass | | | 12:10:04 |
| BPR #1 in tripod | 0057 | <input checked="" type="checkbox"/> | |
| BPR #2 in tripod | 0014 | <input checked="" type="checkbox"/> | |
| Release #1 in tripod | 1349 | <input checked="" type="checkbox"/> | |
| Release #2 in tripod | 358 | <input checked="" type="checkbox"/> | 12:14:13 |

| | |
|--------------------------------|-----------------|
| Ascent Rate | 82 m/min |
| Time at end of recovery | <u>12:14:18</u> |

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **WB4**

Cruise

D382**NB: all times recorded in GMT**Date 18/11/12Site arrival time 13:20Time of first ranging 13:20

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--------|---------------------------|----------|
| 1 x Trimsyn pickup float | | spotted instantly, hooked | 14:00:00 |
| 3 TRYMSYN floats | | | 14:10:42 |
| MicroCAT | 4071 | heavy fouling | 14:11:24 |
| 32" syntactic | | | 14:17:22 |
| with Argos beacon | | arial broken | |
| and light | | y01-023 | |
| Swivel | | | |
| RCM11 | 445 | | 14:18:40 |
| MicroCAT | 4070 | | 14:23:48 |
| 49" syntactic | | | 14:27:19 |
| with Argos beacon | | z08-046 | |
| and light | | z02-018 | |
| swivel | | | |
| MicroCAT | 5787 | | 14:34:22 |
| Nortek | 5963 | | 14:37:31 |
| MicroCAT | 5779 | | 14:37:36 |
| MicroCAT | 5786 | | 14:44:22 |
| Nortek | 6751 | | 14:47:51 |
| MicroCAT | 6827 | | 14:47:54 |
| MicroCAT | 7362 | | 14:54:36 |
| 10 x Orange CF-16s | | tangled | 14:58:22 |
| Nortek | 6743 | | 14:59:02 |
| MicroCAT | 7470 | | 14:59:14 |
| Nortek | 9406 | | 15:16:51 |
| 5 x yellow CF-16s | | | 15:21:01 |
| MicroCAT | 6840 | | 15:23:47 |
| 5 x yellow CF-16s | | | 15:30:30 |
| Swivel | | | |
| Nortek | 9439 | | 15:30:46 |
| MicroCAT | 6124 | changed drum | 16:00:00 |
| 5 x yellow CF-16s | | | |
| MicroCAT | 6326 | | 16:04:00 |
| 5 x yellow CF-16s | | | |

| | | | |
|---------------------|------|-------------------------------------|----------|
| Swivel | | | |
| Nortek | 9433 | <input checked="" type="checkbox"/> | 16:14:17 |
| MicroCAT | 6325 | <input checked="" type="checkbox"/> | 16:15:40 |
| 5 x yellow CF-16s | | | |
| MicroCAT | 6323 | <input checked="" type="checkbox"/> | 16:23:13 |
| 5 x yellow CF-16s | | | 16:35:49 |
| Swivel | | | |
| Nortek | 9420 | <input checked="" type="checkbox"/> | 16:36:04 |
| MicroCAT | 6320 | <input checked="" type="checkbox"/> | 16:38:51 |
| MicroCAT | 6137 | <input checked="" type="checkbox"/> | 16:48:41 |
| Nortek | 5885 | <input checked="" type="checkbox"/> | 16:52:41 |
| 10x glass spheres | | | 16:55:44 |
| Swivel | | | |
| Acoustic release #1 | 1465 | <input checked="" type="checkbox"/> | 16:55:46 |
| Acoustic release #2 | 1463 | <input checked="" type="checkbox"/> | 16:55:48 |

Ascent Rate n/a
Time at end of recovery 16:57:53 ipad time: plus 55 sec.

Ranging

[illegible]

Mooring **WB6**Cruise **D382****NB: all times recorded in GMT**Date 14/11/12
Time of first ranging 13:26Site arrival time 13:25

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--|----------------------------------|----------|
| 1 x Trymsyn pickup float | 12" glass. | surfaced 14:47 | |
| Billings float | not trimsyn | billings not on surface. tangled | lost |
| Argos | | so hooked with pole | lost |
| Light | | | lost |
| 3 x 17" glass | | | 15:22:00 |
| Swivel | | | |
| SBE MicroCAT | 5240 <input checked="" type="checkbox"/> | | 15:25:22 |
| SBE MicroCAT | 6128 <input checked="" type="checkbox"/> | | 15:31:14 |
| 2 x 17" glass | | imploded | 15:33:45 |
| SBE MicroCAT | 5767 <input checked="" type="checkbox"/> | tangled with imploded glass | 15:33:48 |
| Nortek | 6747 <input checked="" type="checkbox"/> | | 15:39:45 |
| SBE MicroCAT | 7361 <input checked="" type="checkbox"/> | above nortek | 15:39:49 |
| SBE MicroCAT | 4306 <input checked="" type="checkbox"/> | | 15:42 |
| 8 x 17" glass | | | 15:46:04 |
| Swivel | | | |
| BPR #1 on tripod | 0390 <input checked="" type="checkbox"/> | | 15:47 |
| BPR #2 on tripod | 0040 <input checked="" type="checkbox"/> | | 15:47 |
| Release #1 in tripod | 1201 <input checked="" type="checkbox"/> | | 15:47 |
| Release #2 in tripod | 910 <input checked="" type="checkbox"/> | | 15:47 |

Ascent Rate 60m/min iPad time = GMT + 48
Time at end of recovery 15:47 secs.

RECOVERY

Mooring **WBADCP**Cruise **D382**

NB: all times recorded in GMT

Date 21/11/12

Site arrival time 17:55

Time of first ranging _____

| ITEM | SER NO | COMMENT | TIME |
|----------------------------|--|-------------------------|----------|
| 1 x 12" glass pickup float | | | 18:11:26 |
| ADCP in 40 " syntactic | 5817 <input checked="" type="checkbox"/> | tangled and upside down | 18:15:38 |
| with Argos beacon | | | |
| and light | | | |
| swivel | | | |
| Acoustic Release #1 | 1464 | | |
| Acoustic Release #2 | 821 | | 18:26:42 |

Ascent Rate 40 m min

Time at end of recovery 18:26:42

Ranging

[illegible]

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **WBAL2**Cruise **D382****NB: all times recorded in GMT**Date 21/11/12Site arrival time 19:05Time of first ranging 19.07

| ITEM | SER NO | COMMENT | TIME |
|---------------------------|--|---------|----------|
| 1 x Trymsyn pick up float | | | 14:42 |
| Billings float | | | |
| ARGOS | | Y01-012 | |
| LIGHT | | Y01-016 | |
| 4 x 17" glass | | | 14:53 |
| 4 x 17" glass | | | |
| 4 x 17" glass | | | |
| BPR #1 in tripod | 417 <input checked="" type="checkbox"/> | | 20:03:56 |
| BPR #2 in tripod | 0039 <input checked="" type="checkbox"/> | | 20:04:01 |
| Release #1 in tripod | | 1352 | 20:04:14 |
| Release #2 in tripod | Text | 364 | 20:04:17 |

tripot almost lost with BPRs

Ascent Rate indeterminate

Time at end of recovery 20:04

Ranging

| Time | Range 1 | Range 2 | Command/comment |
|----------|---------|---------|------------------------------|
| 19:07:36 | - | 678 | arm+arm 1352 |
| 19:08:01 | 679 | 681 | |
| 19:08:55 | 690 | 691 | arm+arm ok |
| 19:09:25 | 694 | 695 | ok |
| 19:09:50 | 696 | 696 | ok |
| 19:10:20 | - | 687 | ok |
| 19:11:00 | 682 | 682 | ok |
| 19:11:55 | - | 680 | 364 arm+arm |
| 19:12:35 | 682 | 684 | |
| 19:13:15 | 684 | 683 | 364 arm+release ok |
| 19:13:45 | 681 | 671 | ok |
| 19:14:20 | 678 | 676 | ok |
| 19:15:20 | 650 | 647 | 1352 arm+diag vertical 8.6 v |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

RAPID-WATCH MOORING LOGSHEET

RECOVERY

Mooring **WBH2**Cruise **D382****NB: all times recorded in GMT****Date** 21 nov 2012**Site arrival time** overnight**Time of first ranging** 12.27

| ITEM | SER NO | COMMENT | TIME |
|--------------------------|--|------------------|----------|
| 1 x Trymsyn pickup float | n/a | | 14.08 |
| Billings float | n/a | | |
| ARGOS | | z08-043 111852 | 14:14:03 |
| Light | | z08-047 | |
| 12x 17" glass | n/a | | 14:18:09 |
| Swivel | n/a | | |
| Nortek | 9402 <input checked="" type="checkbox"/> | | 14:23:58 |
| 7 x 17" glass | n/a | | 14:38:08 |
| Nortek | 9427 <input checked="" type="checkbox"/> | tangled in glass | 14:38:20 |
| Nortek | 9444 <input checked="" type="checkbox"/> | | 14:54:28 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Nortek | 6132 <input checked="" type="checkbox"/> | | 15:09:57 |
| MicroCAT | 6825 <input checked="" type="checkbox"/> | tangled in glass | 15:10:10 |
| MicroCAT | 6824 <input checked="" type="checkbox"/> | | 15:22:54 |
| 3 x 17" glass | n/a | | 15:28:46 |
| Nortek | 5879 <input checked="" type="checkbox"/> | tangled in glass | 15:28:39 |
| MicroCAT | 4305 <input checked="" type="checkbox"/> | | 15:34:35 |
| 5 x 17" glass | n/a | 2 glass imploded | 15:35:23 |
| Swivel | n/a | | |
| Release #1 | 1405 <input checked="" type="checkbox"/> | | 15:35:49 |
| Release #2 | 216 <input checked="" type="checkbox"/> | | 15:35:52 |

Ascent Rate 100m/min**Time at end of recovery** 15.35

Ranging

[illegible]

22 Mooring Deployment Logsheets

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EB1L9**Cruise **D382**

NB: all times recorded in GMT

Date 24/10/12

Site arrival time 16:33:53

| | |
|-----------------------|---------|
| Setup distance | 1 cable |
|-----------------------|---------|

End time 16:40:27

| | |
|------------|-------|
| Start time | 16:35 |
|------------|-------|

Start Position _____

| | | | |
|-----------------|--------------|------------------|---------------|
| Latitude | <u>23.80</u> | Longitude | <u>-24.11</u> |
|-----------------|--------------|------------------|---------------|

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 16:35:01 |
| Billings Float | n/a | | 16:36:30 |
| with Light | y01-020 | | |
| and Argos Beacon | | Beacon ID =93792 | |
| 3 x 17" glass | n/a | | 16:37:19 |
| 3 x 17" glass | n/a | | 16:37:55 |
| 3 x 17" glass | n/a | | 16:38:52 |
| BPR | 392 | | |
| BPR | 420 | | |
| Acoustic Release #1 | 1353 | Record codes below | |
| Acoustic Release #2 | 368 | Record codes below | |
| 300kg Anchor | n/a | | 16:40:27 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID



lander obs goin down

93792

Anchor Drop Position

Latitude 23.7998

Longitude -24.1119

Uncorrected water depth 5053 (at anchor launch)

| | | |
|-------------------------|------|--------------------|
| Uncorrected water depth | 5096 | (at anchor launch) |
| Corrected water depth | 5096 | (at anchor launch) |

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

setup distance increased
due to advice from bridge
re. .3/.4 knot following
current

Mooring **EB1**Cruise **D382****NB: all times recorded in GMT****Date** 25/10/12**Site arrival time** 07:26:01**Setup distance** 5.5 nm**Start time** 07:37:56**End time** 11:38:44**Start Position****Latitude** 23.6647 **Longitude** -24.1389

| ITEM | SER NO | COMMENT | TIME |
|------------------------------|---------|--------------------|----------|
| Recovery line | n/a | | 07:37:49 |
| 3 x Mini-Trimsyns | n/a | 2 trimsyn | |
| MicroCAT | 4066 | | |
| 24" syntactic float | n/a | | 07:42:35 |
| with Light | 208-049 | on and working | |
| and Argos Beacon | W03-082 | Beacon ID =82952 | |
| Swivel | n/a | | |
| MicroCAT | 4713 | | 07:44:39 |
| 37" steel sphere | n/a | | 07:51:53 |
| with light | W03-097 | on and working | |
| and Argos Beacon | 285 | Beacon ID = 60211 | |
| Swivel | n/a | | |
| MicroCAT | 4720 | | 07:53:19 |
| MicroCAT | 4718 | speed up to 1 knot | 07:57:19 |
| MicroCAT | 6817 | | 08:01:25 |
| MicroCAT | 5765 | | 08:05:58 |
| 4 x 17" glass | n/a | | 08:11:37 |
| MicroCAT | 4474 | | 08:15:59 |
| 4 x 17" glass | n/a | | 08:24:37 |
| MicroCAT | 4473 | | 08:26:46 |
| MicroCAT | 4466 | fell over on deck | 08:33:48 |
| 4 x 17" glass | n/a | | 08:39:48 |
| Swivel | | | |
| MicroCAT | 4462 | | 08:42:58 |
| RCM11 | 518 | | 08:52:55 |
| 4 x 17" glass | n/a | | 08:55:55 |
| MicroCAT | 3259 | | 08:58:54 |
| MicroCAT | 3257 | | 09:06 |
| 4 x 17" glass | n/a | | 09:14:14 |
| Swivel | | | |
| MicroCAT | 3255 | | 09:19:22 |
| MicroCAT | 3271 | 3.4 miles to run | 09:28:54 |
| 4 x 17" glass | n/a | | 09:36:37 |
| Swivel | | | |
| MicroCAT | 5238 | 3.0 miles to run | 09:42:14 |

| | | | |
|---------------------|------|-------------------------------------|----------|
| 4 x 17" glass | n/a | | 09:51:49 |
| MicroCAT | 3916 | 2.7 miles to run | 09:55:12 |
| 4 x 17" glass | n/a | | 10:08:06 |
| Swivel | | | |
| MicroCAT | 3256 | | 10:09:28 |
| RCM11 | 507 | | 10:28:36 |
| MicroCAT | 6829 | | 10:29:51 |
| 8 x 17" glass | n/a | rem 20 m wire | |
| Swivel | n/a | | |
| Acoustic Release #1 | 1535 | Record codes below | 10:40:01 |
| Acoustic Release #2 | 1536 | Record codes below | |
| 1450kg Anchor | n/a | starting towing 10:55, 1.5 nm to go | 11:38:44 |

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID



ipad has a +16 sec time offset today

Anchor Drop Position

Latitude 23.7574

Longitude -24.1581

Uncorrected water depth

5053 (at anchor launch)

Corrected water depth

5096 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBH1L9**Cruise **D382****NB: all times recorded in GMT****Date** 16/10/12**Site arrival time** 07:55:54**Setup distance** 3 cables**Start time** 08:09:44**End time** 08:14:28**Start Position****Latitude** 27.2116 **Longitude** -15.4038

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 08:09:51 |
| Billings Float | n/a | | 08:10:38 |
| with Light | S01-185 | | |
| and Argos Beacon | A08-070 | Beacon ID = | |
| 3 x 17" glass | n/a | | 08:11:21 |
| 3 x 17" glass | n/a | | 08:11:48 |
| 3 x 17" glass | n/a | 4 glass | 08:12:26 |
| BPR | 0389 | | |
| BPR | 400 | | |
| Acoustic Release #1 | 265 | Record codes below | |
| Acoustic Release #2 | 347 | Record codes below | |
| 300kg Anchor | n/a | | 08:14:28 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**121991

_____ readjusting to 1.5 cables


Anchor Drop Position**Latitude** 27.2122**Longitude** -15.4029**Uncorrected water depth** 3011.5 (at anchor launch)**Corrected water depth** 3014.6 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBH1**Cruise **D382****NB: all times recorded in GMT****Date** 16/10/12**Site arrival time** 06:38:23**Setup distance** 4 cables**Start time** 06:43:04**End time** 07.15**Start Position****Latitude** 27.2145 **Longitude** -15.4306

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 06:50:48 |
| Billings Float | n/a | | 06:51:36 |
| with Light | | on and flashing | |
| and Argos Beacon | a08-071 | Beacon ID =121992 | |
| 2 x 17" glass | n/a | | 06:52:12 |
| Swivel | n/a | | |
| MicroCAT | 3251 | | 06:52:48 |
| 2 x 17" glass | n/a | | 07:00:22 |
| RCM11 | 450 | | 07:04:12 |
| MicroCAT | 5766 | | 07:06:40 |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 1351 | Record codes below | 07.15.23 |
| Acoustic Release #2 | 251 | Record codes below | |
| 500kg Anchor | n/a | | |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**


 121992

overrunning the waypoint for depth

Anchor Drop Position**Latitude** 27.2224**Longitude** -15.4227**Uncorrected water depth** 3035.5 (at anchor launch)**Corrected water depth** 3038.9 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBH2**Cruise **D382****NB: all times recorded in GMT****Date** 16/10/12**Site arrival time** 16:55:42**Setup distance** 3 cables**Start time** 17:16:39**End time** 17:31:06**Start Position****Latitude** 27.6094 **Longitude** -14.2126

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|------------------------|----------|
| Recovery line | n/a | | 17:16:35 |
| Billings Float | n/a | | 17:17:31 |
| with Light | s01-181 | | |
| and Argos Beacon | a08-069 | Beacon ID = | |
| 2 x 17" glass | n/a | | 17:18 |
| Swivel | n/a | | |
| MicroCAT | 3207 | | |
| 2 x 17" glass | n/a | mcats 3252 after glass | 17:24:50 |
| RCM11 | 516 | | 17:27:02 |
| MicroCAT | 3220 | | |
| 3 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 1346 | Record codes below | |
| Acoustic Release #2 | 1534 | Record codes below | |
| 500kg Anchor | n/a | | 17:31:06 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**121990**Anchor Drop Position****Latitude** 27.6109**Longitude** -14.2123**Uncorrected water depth** 2020 (at anchor launch)**Corrected water depth** 2020 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

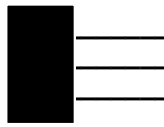
Mooring **EBH3**Cruise **D382****NB: all times recorded in GMT**Date 17/10/12Site arrival time 13:00Setup distance 1.5 nmStart time 13:43:41End time 15:07

Start Position

Latitude 27.7841 Longitude -13.7549

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|----------------------------|----------|
| Recovery line | n/a | | 13:43:47 |
| Billings Float | n/a | | |
| with Light | X01-049 | | |
| and Argos Beacon | A08-068 | Beacon ID = | |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 3212 | | 13:44:27 |
| MicroCAT | 3277 | | 13:48:06 |
| MicroCAT | 6823 | | 13:50:44 |
| MicroCAT | 4712 | | 13:53:09 |
| 3 x 17" glass | n/a | | |
| MicroCAT | 6816 | | 13:58:46 |
| MicroCAT | 5777 | | 14:01:30 |
| 3 x 17" glass | n/a | rcm 428 | 14:17:54 |
| RCM11 | 443 | mcats 4710 | |
| MicroCAT | 3912 | mcats 3213 | |
| MicroCAT | 3893 | | |
| 2 x 17" glass | n/a | | |
| MicroCAT | 3249 | mark measured as deploying | 14:33:07 |
| RCM11 | 444 | | 14:36:27 |
| MicroCAT | 5772 | winding on polyester | |
| 3 x 17" glass | n/a | | |
| MicroCAT | 3214 | | 14:54:28 |
| RCM11 | 515 | | 14:58:28 |
| MicroCAT | 3253 | | |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 825 | Record codes below | |
| Acoustic Release #2 | 1345 | Record codes below | |
| 500kg Anchor | n/a | | 15:07:17 |

Release #1 arm code
 Release #1 release code
 Release #2 arm code
 Release #2 release code



| | |
|---------------------------------|-----------------------------------|
| Argos beacon #1 ID | <u>121989</u> |
| Anchor Drop Position | |
| Latitude <u>27.81321</u> | Longitude <u>-13.74465</u> |
| Uncorrected water depth | <u>1422</u> (at anchor launch) |
| Corrected water depth | <u>1424</u> (at anchor launch) |

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBH4L4**Cruise **D382****NB: all times recorded in GMT**Date 28/10/12Site arrival time 07:47:56Setup distance 1 cableStart time 07:52:59End time 08:01:38

Start Position

Latitude 27.8716 Longitude -13.5149

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 07:52:33 |
| Billings Float | n/a | | 07:53:12 |
| with Light | A08-087 | | |
| and Argos Beacon | Y01-028 | Beacon ID = | |
| 3 x 17" glass | n/a | 4 glass | 07:53:46 |
| 3 x 17" glass | n/a | 4 glass | 07:54:45 |
| 3 x 17" glass | n/a | 4 glass | 07:55:00 |
| BPR | 0037 | | |
| BPR | 0053 | | |
| Acoustic Release #1 | 908 | Record codes below | |
| Acoustic Release #2 | 1242 | Record codes below | |
| 300kg Anchor | n/a | | 08:01:38 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

ipad +4 secs

also adjusted fr clock change

automatically

46501

Anchor Drop Position


Latitude 27.8720Longitude -13.5140Uncorrected water depth 1004.5 (at anchor launch)Corrected water depth 1008.5 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBH4**Cruise **D382****NB: all times recorded in GMT****Date** 28/10/12**Site arrival time** 12:44:17**Setup distance** 1.2 nm**Start time** 12:53:11**End time** 14:15:42**Start Position****Latitude** 27.8709 **Longitude** -13.5454

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--|----------|
| Recovery line | n/a | | 12:52:58 |
| Billings Float | n/a | | 12:53:27 |
| with Light | Z08-050 | | |
| and Argos Beacon | A08-075 | Beacon ID = | |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 3230 | | 12:54 |
| MicroCAT | 3215 | | 12:57:06 |
| 3 x 17" glass | n/a | | 13:01:37 |
| MicroCAT | 6818 | | 13:03:23 |
| MicroCAT | 3244 | | 13:06:30 |
| 2 x 17" glass | n/a | | 13:10:59 |
| MicroCAT | 3224 | | 13:12:05 |
| MicroCAT | 3265 | | 13:16:47 |
| 2 x 17" glass | n/a | | 13:21:32 |
| MicroCAT | 3264 | | 13:22:38 |
| MicroCAT | 6831 | | 13:27:02 |
| 2 x 17" glass | n/a | | |
| MicroCAT | 3216 | | |
| MicroCAT | 3907 | sonetek d332, pointing down, at 13:41:35 | 13:44:32 |
| 6 x 17" glass | n/a | | 13:50:06 |
| Swivel | n/a | towing from 13:58:18 | |
| Acoustic Release #1 | 246 | Record codes below | 13:55:14 |
| Acoustic Release #2 | 1354 | Record codes below | |
| 700kg Anchor | n/a | | 14:15:42 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**


121996
Anchor Drop Position**Latitude** 27.8495**Longitude** -13.5405**Uncorrected water depth** 1053 (at anchor launch)


Corrected water depth: 1056.5

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **EBHi**Cruise **D382****NB: all times recorded in GMT****Date** 23/10/12**Site arrival time** 08:42:30**Setup distance** 5 cables**Start time** 08:42**End time** 09:15:16**Start Position****Latitude** 24.93667 **Longitude** -21.26390

| ITEM | SER NO | COMMENT | TIME |
|---------------------|----------|--------------------|----------|
| Recovery line | n/a | | 08:43:41 |
| Billings Float | n/a | | |
| with Light | tY01-021 | | |
| and Argos Beacon | 202-008 | Beacon ID = 53157 | |
| 2 x 17" glass | n/a | | 08:44:11 |
| Swivel | n/a | | |
| MicroCAT | 3247 | | 08:44:26 |
| 2 x 17" glass | n/a | | 08:58:37 |
| MicroCAT | 3484 | | 08:58:58 |
| RCM11 | 451 | | 09:07:55 |
| MicroCAT | 6819 | | 09:10:08 |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 1533 | Record codes below | |
| Acoustic Release #2 | 1348 | Record codes below | |
| 500kg Anchor | n/a | | 09:15:16 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**


53157
Anchor Drop Position**Latitude** 24.93288**Longitude** -21.27319**Uncorrected water depth**4469 (at anchor launch)**Corrected water depth**4495 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR0**Cruise **D382****NB: all times recorded in GMT**Date 10/11/12Site arrival time 10:10Setup distance 3 cablesStart time 11:13:22End time 11:30:17

Start Position

Latitude 25.1131 Longitude -52.0207

| ITEM | SER NO | COMMENT | TIME |
|---------------------|----------|---------------------|----------|
| Recovery line | n/a | | 11:13:59 |
| Billings Float | n/a | | |
| with Light | Z02-022 | | |
| and Argos Beacon | A08-072 | Beacon ID =121993 | |
| 2-x 17" glass | n/a | 3 glass | |
| Swivel | | | |
| MicroCAT | 3284 | | 11:20:43 |
| MicroCAT | 6324 | | |
| 2-x 17" glass | n/a | 3 glass | 11:22:52 |
| MicroCAT | 5788 | | |
| S4 | 35612564 | | 11:24:21 |
| MicroCAT | 6809 | | 11:25:52 |
| MicroCAT | 3903 | | |
| 8 x 17" glass | n/a | | 11:26:43 |
| SBE26 BPR | 62 | | |
| SBE53 BPR | 79 | | |
| Acoustic Release #1 | 923 | Record codes below | |
| Acoustic Release #2 | 249 | Record codes below | |
| 600kg Anchor | n/a | descending 90 m min | 11:30:17 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID



ipad plus 40 seconds

121993

Anchor Drop Position

Latitude 25.1113Longitude -52.0171Uncorrected water depth 5430 (at anchor launch)Corrected water depth 5489 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR1L8**Cruise **D382****NB: all times recorded in GMT****Date** 09/11/12**Site arrival time** overnight**Setup distance** 1 cable**Start time** 09:14:24**End time** 09:23:04**Start Position****Latitude** 24.1957 **Longitude** -49.7158

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 09:18:43 |
| Billings Float | n/a | | 09:19:20 |
| with Light | U01-078 | on and flashing | |
| and Argos Beacon | A08-078 | Beacon ID =0N | |
| 3 x 17" glass | n/a | | 09:20:09 |
| 3 x 17" glass | n/a | | 09:20:31 |
| 3 x 17" glass | n/a | | 09:21:07 |
| BPR | 0059 | | |
| BPR | 0080 | | |
| Acoustic Release #1 | 822 | Record codes below | |
| Acoustic Release #2 | 1203 | Record codes below | |
| 300kg Anchor | n/a | corrected 09:22:26 | 09:23:04 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**121997**Anchor Drop Position****Latitude** 24.1953**Longitude** -49.7140**Uncorrected water depth** _____ (at anchor launch)**Corrected water depth** 5221.5 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR1**Cruise **D382****NB: all times recorded in GMT****Date** 8/11/2012**Site arrival time** 16:08**Setup distance** 5 miles**Start time** 17:27**End time** 21:35:27**Start Position****Latitude** 24.1697 **Longitude** -49.8420

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 17:27 |
| 3 x Mini-Trimsyn | n/a | | 17:27 |
| MicroCAT | | | 17:27 |
| 24" syntactic float | n/a | | 17:30 |
| with Light | Z02-023 | | |
| and Argos Beacon | A08-067 | Beacon ID = 121988 | |
| Swivel | n/a | | |
| MicroCAT | 5244 | | 17:31 |
| 37" Steel Sphere | | | 17:38:08 |
| with Light | w03/094 | | |
| and Argos Beacon | | Beacon ID = 82895 | |
| Swivel | n/a | | |
| MicroCAT | 4060 | | 17:41:42 |
| MicroCAT | 3281 | | 17:45:22 |
| MicroCAT | 6834 | | 17:48:55 |
| MicroCAT | 6839 | | 17:52:51 |
| MicroCAT | 6838 | | 17:58:51 |
| 8 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 4062 | | |
| MicroCAT | 6833 | | 18:10:16 |
| MicroCAT | 3901 | | 18:16:10 |
| RCM11 | 519 | | 18:31:07 |
| MicroCAT | 3904 | | 18:34:37 |
| 8 x 17" glass | n/a | | 18:42:21 |
| Swivel | n/a | | |
| MicroCAT | 7681 | | 18:47:44 |
| 4 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 3229 | | 19:01:09 |
| 4 x 17" glass | n/a | | 19:13:18 |
| Swivel | n/a | | 19:13:25 |
| MicroCAT | 6112 | speed up | 19:14:17 |
| 4 x 17" glass | n/a | | 19:25:26 |
| Swivel | n/a | | 19:25:31 |

| | | | |
|---------------------|----------|--------------------|----------|
| MicroCAT | 3254 | | 19:27:01 |
| 4 x 17" glass | n/a | | 19:38:39 |
| Swivel | n/a | | |
| MicroCAT | 3225 | | 19:39:37 |
| MicroCAT | 4468 | | 19:50:53 |
| 5 x 17" glass | n/a | | 19:58:16 |
| Swivel | n/a | | |
| S4 | 35612565 | | 20:14:11 |
| MicroCAT | 6798 | | |
| 9 x 17" glass | n/a | | 20:22:54 |
| Swivel | n/a | | |
| Acoustic Release #1 | 1200 | Record codes below | 20:23:11 |
| Acoustic Release #2 | 319 | Record codes below | 20:23:16 |
| 1800kg Anchor | n/a | | 21:35:27 |

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID
Argos beacon #2 ID



121988

82895

Anchor Drop Position

Latitude 24.16529 N

Longitude 49.74643 W

Uncorrected water depth 5162 (at anchor launch)

Corrected water depth 5212 (at anchor launch)

Time is 32 seconds off GMT.

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR2**Cruise **D382****NB: all times recorded in GMT****Date** 09:25:17**Site arrival time** 10:08**Setup distance** 15 cables**Start time** 10:08**End time** 11:29:22**Start Position****Latitude** 24.1838 **Longitude** -49.7891

| ITEM | SER NO | COMMENT | TIME |
|---------------------|----------|--------------------|----------|
| Recovery line | n/a | | 10:08:13 |
| Billings float | n/a | | 10:08:33 |
| with Light | Y01-018 | on | |
| and Argos Beacon | z02-066 | Beacon ID =0N | |
| 3 x 17" glass | n/a | | 10:09 |
| Swivel | n/a | | |
| MicroCAT | 6811 | 20 m below join | 10:10:52 |
| 5 x 17" glass | n/a | | 10:25:07 |
| Swivel | n/a | | |
| MicroCAT | 3266 | | 10:26:22 |
| MicroCAT | 3222 | | 10:37:57 |
| MicroCAT | 3913 | | 10:48:43 |
| 7 x 17" glass | n/a | | 10:55:40 |
| Swivel | n/a | | |
| S4 | 35612576 | | 10:56:31 |
| Acoustic Release #1 | 264 | Record codes below | 11:01:41 |
| Acoustic Release #2 | 1197 | Record codes below | |
| 500kg Anchor | n/a | corrected 11:28:45 | 11:29:22 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**53153**Anchor Drop Position****Latitude** 24.1777**Longitude** -49.7629**Uncorrected water depth** _____ (at anchor launch)**Corrected water depth** 5214 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR3L8**Cruise **D382****NB: all times recorded in GMT****Date** 05/11/12**Site arrival time** 16:01:17**Setup distance** 2 cables**Start time** 16:01:49**End time** 16:08:09**Start Position****Latitude** 23.8564 **Longitude** -41.1002

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 16:02:14 |
| Billings Float | n/a | | |
| with Light | z02-021 | | |
| and Argos Beacon | y01-010 | Beacon ID = | |
| 3 x 17" glass | n/a | | 16:05:26 |
| 3 x 17" glass | n/a | | 16:05:29 |
| 3 x 17" glass | n/a | | 16:05:32 |
| BPR | 0029 | | |
| BPR | 0031 | | |
| Acoustic Release #1 | 927 | Record codes below | |
| Acoustic Release #2 | 907 | Record codes below | |
| 300kg Anchor | n/a | | 16:08:09 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**


46492

obs going down

Anchor Drop Position**Latitude** 23.8565N**Longitude** 41.0988W**Uncorrected water depth** 5014 (at anchor launch)**Corrected water depth** 5055 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **MAR3**Cruise **D382****NB: all times recorded in GMT****Date** 05/11/12**Site arrival time** 13:49:27**Setup distance** 2.5 nm**Start time** 13:53:21**End time** 15:33:58**Start Position****Latitude** 23.8629 **Longitude** -41.1383

| ITEM | SER NO | COMMENT | TIME |
|---------------------|----------|------------------------|----------|
| Recovery line | n/a | | 13:53:06 |
| Billings float | n/a | | 13:54:10 |
| with Light | a1556 | | |
| and Argos Beacon | Y01-009 | Beacon ID =46491 | |
| 2 x 17" glass | n/a | | |
| Swivel | n/a | | |
| MicroCAT | 6841 | | 13:54:19 |
| 2 x 17" glass | n/a | | 13:58:00 |
| 2 x 17" glass | n/a | | |
| MicroCAT | 6832 | | 14:08:58 |
| 2 x 17" glass | n/a | | 14:18:14 |
| Swivel | n/a | | |
| MicroCAT | 5245 | | 14:19:46 |
| 2 x 17" glass | n/a | | 14:31:15 |
| MicroCAT | 5241 | | 14:32:40 |
| 3 x 17" glass | n/a | | 14:42:51 |
| MicroCAT | 3268 | | 14:44:30 |
| Swivel | n/a | | |
| 3xglass | | | 14:56:42 |
| MicroCAT | 4178 | | 14:58:01 |
| MicroCAT | 3900 | | 15:09:38 |
| 7 x 17" glass | n/a | | 15:17:18 |
| Swivel | n/a | | |
| S4 | 35612577 | s4 went in above glass | 15:15:51 |
| Acoustic Release #1 | 824 | Record codes below | 15:24:38 |
| Acoustic Release #2 | 925 | Record codes below | 15:24:41 |
| 700kg Anchor | n/a | | 15:33:58 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**

ipad plus 30 sec

46491**Anchor Drop Position**

| | | | |
|--------------------------------|----------------|------------------|--------------------|
| Latitude | <u>23.8701</u> | Longitude | <u>-41.090</u> |
| Uncorrected water depth | <u>5015</u> | | (at anchor launch) |
| Corrected water depth | <u>5056</u> | | (at anchor launch) |

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **NOG**Cruise **D382****NB: all times recorded in GMT****Date** 05/11/12**Site arrival time** 20:17:48**Setup distance** 1.5 nm**Start time** 20:17:45**End time** 21:36**Start Position****Latitude** 23.7707 **Longitude** -41.1261

| ITEM | SER NO | COMMENT | TIME |
|---------------------|----------|----------|----------|
| Recovery line | n/a | | 20:17:32 |
| Billings Float | n/a | | |
| with Light | | light on | |
| 12 x 17" glass | n/a | | 20:18:44 |
| Swivel | n/a | | |
| Sediment Trap | 12283-01 | | 20:24:41 |
| Nortek rcm11 | 644 | | |
| Sediment Trap | 12168-03 | | 20:31:33 |
| Nortek rcm11 | 646 | | |
| MicroCAT | 7300 | | |
| 10 x 17" glass | n/a | | 20:55:16 |
| Acoustic Release #1 | 1350 | | 21:02:56 |
| Anchor | n/a | | 21:36:17 |

Release #1 arm code**Release #1 release code****Anchor Drop Position****Latitude** 23.7709N**Longitude** 41.0987W**Uncorrected water depth** 4220 (at anchor launch)**Corrected water depth** 4241 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WB1**Cruise **D382****NB: all times recorded in GMT****Date** 17/11/12**Site arrival time** 16:55:43**Setup distance** 3.5 nm**Start time** 16:56:08**End time** 19:39:19**Start Position****Latitude** 26.4577 **Longitude** -76.8613

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|----------------------------|----------|
| Recovery line | n/a | | 16:59:06 |
| 30" syntactic float | n/a | | 16:59:10 |
| with light | t05-079 | | |
| and Argos Beacon | 46493 | Beacon ID =46493 | |
| Swivel | n/a | | |
| Nortek | 6723 | | 16:59:20 |
| MicroCAT | 5778 | | 16:59:27 |
| 45" syntactic float | n/a | | 17:12:03 |
| with light | hol-009 | | |
| and Argos Beacon | 253 | Beacon ID = 42145 | |
| Swivel | n/a | | |
| Nortek | 6088 | | 17:32:21 |
| MicroCAT | 5783 | | 17:35:23 |
| 10 x 17" glass | n/a | | 17:50:59 |
| Swivel | | | |
| Nortek | 6765 | | 18:00:31 |
| MicroCAT | 6835 | | 18:00:35 |
| 2 x 17" glass | n/a | | 18:16:29 |
| Nortek | 6534 | | 18:16:38 |
| MicroCAT | 5776 | | 18:16:41 |
| 10 x 17" glass | n/a | | 18:26:36 |
| Swivel | n/a | | |
| Acoustic Release #1 | 1201 | Record codes below | 18:26:45 |
| Acoustic Release #2 | 1194 | Record codes below | 18:26:48 |
| 1800kg Anchor | n/a | started towing at 18:29:37 | 19:39:19 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID****Argos beacon #2 ID**

ipad time plus 55 secs

4649342145

Anchor Drop Position**Latitude** 26.5104**Longitude** -76.8172**Uncorrected water depth** 1354.5 (at anchor launch)**Corrected water depth** 1363.0 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WB2L9**Cruise **D382****NB: all times recorded in GMT**Date 20/11/12Site arrival time 22:30Setup distance 1 cableStart time 23:19End time 23:23

Start Position

Latitude 26.5048 Longitude -76.7416

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 23:19:34 |
| Billings Float | n/a | | |
| with Light | a08-082 | light on | |
| and Argos Beacon | a08-074 | Beacon ID = 121995 | |
| 4 x 17" glass | n/a | | |
| 4 x 17" glass | n/a | | 23:19:51 |
| 4 x 17" glass | n/a | | 23:20:24 |
| BPR | 0002 | | |
| BPR | 0060 | | |
| Acoustic Release #1 | 928 | Record codes below | |
| Acoustic Release #2 | 920 | Record codes below | 23:23:32 |
| 600kg Anchor | n/a | | 23:23 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

121995

Anchor Drop Position

Latitude 26.5053Longitude -76.7418Uncorrected water depth 3851 (at anchor launch)Corrected water depth 3870 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WB2**Cruise **D382****NB: all times recorded in GMT****Date** 20/11/12**Site arrival time** 16:00**Setup distance** 6 miles**Start time** 16:00**End time** 20:00**Start Position****Latitude** 26.4195 **Longitude** -76.7000

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|-----------------------------------|----------|
| Recovery line | n/a | | |
| 3 x Mini-Trimsyn | | | 16:02 |
| MicroCAT | 6119 | | 16:02 |
| 30" syntactic float | n/a | | 16:07:20 |
| with light | x01-052 | | |
| and Argos Beacon | y01-026 | Beacon ID =46499 | |
| Swivel | n/a | | |
| RCM11 | 306 | | 16:07:24 |
| MicroCAT | 3932 | | 16:09:18 |
| 51" syntactic float | n/a | | 16:30:00 |
| with light | x01-050 | | |
| and Argos Beacon | 286 | Beacon ID =22442 | |
| Swivel | n/a | | |
| RCM11 | 395 | | 16:30:06 |
| MicroCAT | 7723 | more like 10m below rather than 5 | 16:33:39 |
| MicroCAT | 6830 | | 16:37:38 |
| 2 x 17" glass | n/a | | 16:44:00 |
| Nortek | 6747 | | 16:44:07 |
| MicroCAT | 4717 | | 16:48:10 |
| MicroCAT | 4721 | | 16:53:19 |
| 2 x 17" glass | n/a | | |
| Nortek | 5889 | | 16:58:25 |
| MicroCAT | 6836 | | 17:01:40 |
| MicroCAT | 5774 | | 17:06:16 |
| 10 x 17" glass | n/a | | 17:14:39 |
| Swivel | n/a | | 17:14:45 |
| Nortek | 6805 | | 17:14:55 |
| MicroCAT | 3228 | | 17:17:59 |
| Nortek | 8052 | | 17:25:33 |
| MicroCAT | 3206 | | 17:25:43 |
| 5 x 17" glass | n/a | | 17:33:10 |
| MicroCAT | 3221 | | 17:33:14 |
| MicroCAT | 3269 | | 17:38:02 |
| Nortek | 8120 | | 17:43:29 |
| 5 x 17" glass | n/a | | |

| | | | |
|---------------------|------|--------------------|----------|
| Swivel | n/a | | |
| MicroCAT | 6113 | | 17:52:29 |
| MicroCAT | 6813 | | 18:03:17 |
| 2 x 17" glass | n/a | | 18:09:51 |
| Nortek | 9204 | | 18:10:02 |
| 5 x 17" glass | n/a | | |
| MicroCAT | 6805 | | 18:19:21 |
| MicroCAT | 6815 | | 18:37:52 |
| 10 x 17" glass | n/a | | 18:46 |
| Swivel | n/a | | |
| Acoustic Release #1 | 917 | Record codes below | |
| Acoustic Release #2 | 323 | Record codes below | 20:00:00 |
| 2200kg Anchor | n/a | towing at 18:50 | |

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID
Argos beacon #2 ID



46499
22442

0.5 knot running with ship S-N
 est. time of 4 hours based on
 RB1201
 Mooring completed in 2.75 hrs
 hence long tow

ipad minus 10 secs

Anchor Drop Position

Latitude 26.5185

Longitude -76.7398

Uncorrected water depth

3811 (at anchor launch)

Corrected water depth

3829 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WB4L9**Cruise **D382****NB: all times recorded in GMT**Date 18/11/2012Site arrival time 17.32Setup distance 1 cableStart time 17.32End time 17:36:48

Start Position

Latitude 26.4735 Longitude -75.7031

| ITEM | SER NO | COMMENT | TIME |
|---------------------|-------------|---------------------|----------|
| Recovery line | n/a | | 17:32:12 |
| Billings Float | n/a | | |
| with Light | z02-019 | | 17:32:35 |
| and Argos Beacon | | Beacon ID = z02-005 | |
| 4 x 17" glass | n/a | | 17:33:20 |
| 4 x 17" glass | n/a | | 17:34:03 |
| 4 x 17" glass | n/a | | 17:34:31 |
| BPR | 5336763-000 | | |
| BPR | 5356939-005 | | |
| Acoustic Release #1 | 322 | Record codes below | |
| Acoustic Release #2 | 256 | Record codes below | |
| 600kg Anchor | n/a | | 17:36:48 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID



ipad plus 55 sec

Anchor Drop Position

Latitude 26.4736Longitude -75.7027Uncorrected water depth 4656 (at anchor launch)Corrected water depth 4691 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT





Mooring **WB4**Cruise **D382****NB: all times recorded in GMT****Date** 19/11/2012**Site arrival time** overnight**Setup distance** 4.5 miles**Start time** 12:05:51**End time** 17:23:11**Start Position****Latitude** 26.4005 **Longitude** -75.6844

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|------------------------------------|----------|
| Recovery line | n/a | | 12:07:31 |
| 3 x Mini-Trimsyn | | w03-092 | 12:07:34 |
| MicroCAT | 5247 | | 12:07:39 |
| 32" syntactic float | n/a | | 12:16:21 |
| with light | t05-076 | | |
| and Argos Beacon | z02-003 | Beacon ID = 53128 | |
| Swivel | n/a | | |
| RCM11 | 399 | | 12:16:26 |
| MicroCAT | 5484 | moved down a few meters | 12:18:06 |
| 49" syntactic float | n/a | | 12:35:40 |
| with light | | argos beacon id: 111853 | |
| and Argos Beacon | z08-046 | Beacon ID = | |
| Swivel | n/a | | 12:38:59 |
| MicroCAT | 3219 | | 12:38:59 |
| Nortek | 5590 | | 12:51:28 |
| MicroCAT | 6810 | | 12:51:32 |
| MicroCAT | 3891 | | 13:00:15 |
| Nortek | 5611 | | 13:10:59 |
| MicroCAT | 3233 | | 13:11:06 |
| MicroCAT | 5789 | | 13:18:18 |
| 10 x Orange CF-16s | n/a | | 13:34:52 |
| Swivel | n/a | | |
| Nortek | 5831 | | 13:40:30 |
| MicroCAT | 6807 | | 13:40:34 |
| Nortek | 5893 | | 13:52:11 |
| 5 x Yellow CF-16s | n/a | | 13:59:12 |
| MicroCAT | 3234 | | 14:01:05 |
| 5 x Yellow CF-16s | n/a | | 14:13:31 |
| Swivel | n/a | | |
| Nortek | 5896 | 14:17:00 | |
| MicroCAT | 3232 | | 14:17:05 |
| 5 x Yellow CF-16s | n/a | | 14:33:27 |
| MicroCAT | 6114 | | 14:34:53 |
| 5 x Yellow CF-16s | n/a | slowing down ship because problems | 15:05:46 |
| Swivel | n/a | with crane need fixing. | |

crane problems resolved 15:02

| | | | |
|---------------------|------|--|----------|
| Nortek | 5899 | | 15:09:29 |
| MicroCAT | 6804 | | 15:09:36 |
| 5 x Yellow CF-16s | n/a | | 15:24:08 |
| Swivel | n/a | + another microcat: 5486 | 15:25:46 |
| Nortek | 5955 | rugby floats before | 15:42:59 |
| MicroCAT | 6801 | taped up wire after mc - split in plastic. | 15:43:04 |
| MicroCAT | 6802 | | 16:10:39 |
| Nortek | 6049 | taking out 60m, replacing it with a 20m | 16:24:09 |
| 10 x 17" glass | n/a | | |
| Swivel | n/a | | |
| Acoustic Release #1 | 910 | Record codes below | 17:00 |
| Acoustic Release #2 | 316 | Record codes below | |
| 2700kg Anchor | n/a | | 17:23:11 |

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID
Argos beacon #2 ID





53128
111853

ipad = gmt + 61 seconds

Anchor Drop Position

Latitude 26.4819

Longitude -75.7028

Uncorrected water depth 4659 (at anchor launch)

Corrected water depth 4695 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WB6**Cruise **D382****NB: all times recorded in GMT****Date** 14/11/12**Site arrival time** 16:18:41**Setup distance** 3 cables**Start time** 16:20:46**End time** 16:35:15**Start Position****Latitude** 26.4906 **Longitude** -70.5238

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 16:20:51 |
| Billings Float | n/a | | |
| with Light | n08-027 | | |
| and Argos Beacon | a08-073 | Beacon ID = | |
| 3 x 17" glass | n/a | | 16:22:07 |
| Swivel | | | |
| MicroCAT | 4708 | | 16:22:28 |
| MicroCAT | 5978 | | 16:26:08 |
| 2 x 17" glass | n/a | | |
| MicroCAT | 4797 | | 16:28 |
| Nortek | 6050 | | 16:30:31 |
| MicroCAT | 4800 | | 16:30:38 |
| MicroCAT | 6812 | | 16:32:44 |
| 8 x 17" glass | n/a | | 16:33:08 |
| SBE26 BPR | 0394 | | |
| SBE53 BPR | 0081 | | |
| Acoustic Release #1 | 819 | Record codes below | |
| Acoustic Release #2 | 281 | Record codes below | |
| 600kg Anchor | n/a | | 16:35:15 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**121994

ipad plus 48 seconds

descending 60 m min

Anchor Drop Position**Latitude** 26.4942**Longitude** -70.5226**Uncorrected water depth** 5437 (at anchor launch)**Corrected water depth** 5497 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WBADCP**Cruise **D382****NB: all times recorded in GMT**Date 22/11/12Site arrival time 21:00Setup distance 1 cableStart time 21:04End time 21:07:52

Start Position

Latitude 26.5249 Longitude -76.8675

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|-----------------------------------|----------|
| Recovery line | n/a | | |
| ADCP in float | 10311 | not released brought against ship | 21:04:29 |
| with Light | a08079 | | |
| and Argos Beacon | y01-012 | Beacon ID = 46494 | |
| Swivel | n/a | | |
| Acoustic Release #1 | 906 | Record codes below | |
| Acoustic Release #2 | 497 | Record codes below | |
| 800kg Anchor | n/a | | 21:07:52 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

46494

Anchor Drop Position

Latitude 26.5251Longitude -76.8676Uncorrected water depth 606 (at anchor launch)Corrected water depth 615 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WBAL4**Cruise **D382****NB: all times recorded in GMT**Date 22/11/12Site arrival time 21.30Setup distance 1 cableStart time 21.35End time 21.41.36

Start Position

Latitude 26.5247 Longitude -76.8761

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 21:35:02 |
| Billings Float | n/a | | |
| with Light | a08-078 | | |
| and Argos Beacon | z08-045 | Beacon ID = 111852 | |
| 4 x 17" glass | n/a | | |
| 4 x 17" glass | n/a | | |
| 4 x 17" glass | n/a | | |
| BPR | | | |
| BPR | | | |
| Acoustic Release #1 | 1195 | Record codes below | |
| Acoustic Release #2 | 320 | Record codes below | |
| 600kg Anchor | n/a | | 21.41.36 |

Release #1 arm code

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

111852

Anchor Drop Position

Latitude 26.5247Longitude -76.8760Uncorrected water depth 485 (at anchor launch)Corrected water depth 493 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET

DEPLOYMENT

Mooring **WBH2**Cruise **D382****NB: all times recorded in GMT****Date** 22/11/12**Site arrival time** 12:04:37**Setup distance** 3 miles**Start time** 12:05:46**End time** _____**Start Position****Latitude** 26.4338 **Longitude** -76.6019

| ITEM | SER NO | COMMENT | TIME |
|---------------------|---------|--------------------|----------|
| Recovery line | n/a | | 12:06:05 |
| Billings Float | n/a | | 12:06:59 |
| with Light | a08-081 | | |
| and Argos Beacon | y08-081 | Beacon ID = 46485 | |
| 12 x 17" glass | n/a | | 12:09:53 |
| Swivel | n/a | | |
| Nortek | 9210 | | 12:13:01 |
| 7 x 17" glass | n/a | | 12:28:47 |
| Nortek | 9213 | | 12:30:00 |
| Nortek | 9435 | | 12:51:00 |
| 3 x 17" glass | n/a | | 13:08:58 |
| Swivel | | | |
| Nortek | 5490 | | 13:09:04 |
| MicroCAT | 3905 | | 13:12:00 |
| MicroCAT | 6799 | 13:55:00 | |
| 3 x 17" glass | n/a | 14:03:40 | |
| RCM11 | 426 | 14:03:46 | |
| MicroCAT | 6800 | | 14:06:46 |
| 5 x 17" glass | | | 14:09:04 |
| Acoustic Release #1 | 827 | Record codes below | 14:21:25 |
| Acoustic Release #2 | 687 | Record codes below | 14:21:29 |
| 1550kg Anchor | n/a | towing at 14:10:15 | 14:50:07 |

Release #1 arm code**Release #1 release code****Release #2 arm code****Release #2 release code****Argos beacon #1 ID**46485**Anchor Drop Position****Latitude** 26.4857**Longitude** -76.6293**Uncorrected water depth** 4678 (at anchor launch)**Corrected water depth** 4714.3 (at anchor launch)

Appendices

A Configuration of Sea-Bird 911 CTD

Stainless CTD frame:

Date: 10/09/2012

Instrument configuration file:

C:\Program Files\Sea-Bird\SeasaveV7\D382\D382_0869_NMEA.xmlcon

Configuration report for SBE 911plus/917plus CTD

Frequency channels suppressed : 0
Voltage words suppressed : 2
Computer interface : RS-232C
Deck unit : SBE11plus Firmware Version >= 5.0
Scans to average : 1
NMEA position data added : Yes
NMEA depth data added : No
NMEA time added : No
NMEA device connected to : deck unit
Surface PAR voltage added : No
Scan time added : Yes

1) Frequency 0, Temperature

Serial number : 03P-5494
Calibrated on : 9 May 2012
G : 4.32432899e-003
H : 6.26209304e-004
I : 1.95955803e-005
J : 1.51713616e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

2) Frequency 1, Conductivity

Serial number : 04C-3698
Calibrated on : 8 May 2012
G : -1.01569849e+001
H : 1.43967267e+000
I : -3.44059820e-003

J : 3.39351246e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008
Slope : 1.00000000
Offset : 0.00000

3) Frequency 2, Pressure, Digiquartz with TC

Serial number : 100898
Calibrated on : 6 January 2012
C1 : -4.405863e+004
C2 : -6.206030e-002
C3 : 1.337540e-002
D1 : 3.669100e-002
D2 : 0.000000e+000
T1 : 2.990734e+001
T2 : -3.493620e-004
T3 : 4.061200e-006
T4 : 3.043880e-009
T5 : 0.000000e+000
Slope : 0.99995000
Offset : -1.59900
AD590M : 1.288520e-002
AD590B : -8.271930e+000

4) Frequency 3, Temperature, 2

Serial number : 03P-5495
Calibrated on : 6 July 2012
G : 4.38224268e-003
H : 6.31026077e-004
I : 2.02985691e-005
J : 1.58183621e-006
F0 : 1000.000
Slope : 1.00000000
Offset : 0.0000

5) Frequency 4, Conductivity, 2

Serial number : 04C-3874
Calibrated on : 12 July 2012
G : -1.05030174e+001
H : 1.38921915e+000
I : -1.00129763e-003
J : 1.37088089e-004
CTcor : 3.2500e-006
CPcor : -9.57000000e-008

Slope : 1.00000000
Offset : 0.00000

6) A/D voltage 0, Free

7) A/D voltage 1, Free

8) A/D voltage 2, Altimeter

Serial number : 47597
Calibrated on : 10 March 2010
Scale factor : 15.000
Offset : 0.000

9) A/D voltage 3, Free

Scan length : 35

Spare Stainless CTD frame:

B VmDas control files

B.1 Bottom Track Off

```
;-----\
; ADCP Command File for use with VmDas software.
;
; ADCP type:      75 Khz Ocean Surveyor
; Setup name:     default
; Setup type:     Low resolution, long range profile(narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 27October2008
;-----/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), fifty (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF)
WP0
NP00001
NN065
NS1600
NF0800

; DISABLE single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP000
BX12000

; output velocity, correlation, echo intensity, percent good
ND111100000

; One and a half seconds between bottom and water pings
TP000200
```



```

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000150

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX000000

; Set transducer misalignment (hundredths of degrees)
EA000000

; Set transducer depth (decimeters); Correct for Discovery
ED000053

; Set Salinity (ppt) Is the transducer really seawater? Maybe should be 0?
ES35

; save this setup to non-volatile memory in the ADCP
CK

```

B.2 Bottom Track On

```
;-----\
; ADCP Command File for use with VmDas software.
;
; ADCP type:      75 Khz Ocean Surveyor
; Setup name:     default
; Setup type:     Low resolution, long range profile(narrowband)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 27October2008
;-----/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN) 16 meter bins (
; 8 meter blanking distance (NF)
WPO
NP00001
NN065
NS1600
NF0800

; ENABLE single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX)
BP001
BX12000

; output velocity, correlation, echo intensity, percent good
ND111100000

; One and a half seconds between bottom and water pings
TP000200

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
```

```
; You must set the time between ensemble in the VmDas Communication options
TE00000150

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA00000

; Set transducer depth (decimeters); Correct for Discovery
ED00053

; Set Salinity (ppt) Is the transducer really seawater? Maybe should be 0?
ES35

; save this setup to non-volatile memory in the ADCP
CK
```

C quick_adcp.py control files

q_py<sn>.cnt

The line `--pingtype nb` needs to be modified depending on whether the instrument is running in narrowband (nb) or broadband (bb) mode.

```
--yearbase 2012
--dbname di382<sn>nnx
--datadir /local/users/pstar/cruise/data/vmadcp/di382_os75/rawdata003
--datafile_glob *.ENX
--instname os75
--instclass os
--datatype enx
--auto
--rotate_angle 0.0
--pingtype nb
--ducer_depth 5
```

q_pyedit.cnt

```
#q_pyedit.cnt
##comments follow hash marks; this is a comment line
--yearbase 2012
--steps2rerun apply_edit:navsteps:calib:matfiles
--instname os75
--auto
#end of q_pyedit.cnt
```

q_pytvrot.cnt

```
# q_pyrot.cnt is
## comments follow hash marks; this is a comment line
--yearbase 2012
--steps2rerun navsteps:calib:matfiles
--auto
# end of q_pyrot.cnt
```

q_pyrot.cnt

```
#q_pyrot.cnt
## comments follow hash marks; this is a comment line
--yearbase 2012
--rotate_angle -3.42
--rotate_amp 1.00
--steps2rerun rotate:navsteps:calib:matfiles
--instname os75
--auto
#end of q_pyrot.cnt
```

D Mstar CTD steps

| step | script | example infile(s) | example otfiles | comments | requires previous step |
|------|---------|-------------------------------------|--|---|------------------------------|
| 1 | msam_01 | none | sam_di382_016.nc | create empty sam file (eg list of vars is in sam_di82_varlist.csv) variable list file is kept in directory M_TEMPLATES | - |
| 2 | mctd_01 | ctd_di382_016_ctm.cnv | ctd_di382_016_raw.nc | read in ctd data (may need to be edited for exact ctd file name) | - |
| 3 | mctd_02 | ctd_di382_016_24hz.nc | ctd_di382_016_24hz.nc | rename SBE variable names | 2 |
| 4 | mctd_03 | ctd_di382_016_24hz.nc | ctd_di382_016_1hz.nc ctd_di382_016_psal.nc | average to 1 hz and calculate psal, potemp | 3 |
| 5 | mdcs_01 | None | dcs_di382_016.nc | create empty dcs file; this is used to store information about start, bottom and end of good data in ctd file | - |
| 6 | mdcs_02 | dcs_di382_016.nc | dcs_di382_016.nc | populate dcs file with data to identify bottom of cast | 3,5 |
| 7 | mdcs_03 | dcs_di382_016.nc | dcs_di382_016.nc | populate dcs file with data to identify start and end of cast | 3,6 |
| 8 | mdcs_04 | dcs_di382_016.nc pos_di382_01.nc | ctd_di382_016_surf.nc dcs_di382_016_pos.nc dcs_di382_016_pos.nc ctd_di382_016_raw.nc ctd_di382_016_24hz.nc ctd_di382_016_1hz.nc | merge positions onto ctd start bottom end times (requires nav file) apply positions to set of files. Any of this list have positions set if the file exists The list should be extended to include any other chemistry files, and the winch file if it exists | 7 & nav |

9 mdcs_05 dcs_di382_016_pos.nc

| | | | | | |
|-----|---------|--|--|---|-----------|
| 10 | mctd.04 | ctd_di382_016_psal.nc | ctd_di382_016_psal.nc ctd_di382_016_surf.nc ctd_di382_016_2db.nc fir_di382_016_bl.nc fir_di382_016_time.nc fir_di382_016_winch.nc fir_di382_016_ctd.nc sal_di382_016.nc sam_di382_016.nc sam_di382_016_resid.nc dcs_di382_016.nc ctd_di382_016_2db.nc | It can be used at any time, once step 8 is complete | |
| 11 | mfir.01 | ctd_di382_016.bl | fir_di382_016.bl.nc | extract downcast data from psal file using index information in dcs file; sort, interpolate gaps and average to 2db. | 4,8 |
| 12 | mfir.02 | fir_di382_016_bl.nc ctd_di382_016_1hz.nc | fir_di382_016_time.nc | read in .bl file and create fir file | - |
| 13 | mfir.03 | fir_di382_016_time.nc ctd_di382_016_psal.nc | fir_di382_016_ctd.nc | merge time from ctd onto fir file using scan number | 4,11 |
| 14 | mfir.04 | fir_di382_016_ctd.nc | sam_di382_016.nc | merge ctd upcast data onto fir file | 4,12 |
| 15a | mwin.01 | techsas_files | win_di382_016.nc | paste ctd fir data into sam file times extracted from start and end of ctd 1hz file, plus 10 minutes at either end | 1,13 4 |
| 15 | mwin.03 | fir_di382_016_time | fir_di382_016_winch.nc | merge winch wireout onto fir file (only relevant if winch data available) | 12 & 15a |
| 16 | mwin.04 | win_di382_016.nc fir_di382_016_winch.nc | sam_di382_016.nc | paste win fir data into sam file | 1,15 |
| 17 | msal.01 | none | sal_di382_016.nc | read in the bottle salinities | - |
| 18 | msal.02 | sal_di382_016.nc | sam_di382_016.nc | paste sal data into sam file | 1,17 |
| 19 | msam.02 | sam_di382_016.nc | sam_di382_016_resid.nc | calculate residuals in sam file | 14,18 |

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